A

Project Report

On

Project ID:C-02

IoT-Based Wireless EV Charging System for Electric Vehicle

Submitted

By

YADNESH LAXMIKANT KOTKAR	**120B1E186**
ATHARVA AMOL KUSURKAR	**120B1E188**
SHRUTI UMAKANT PINGALE	**120B1E203**

Under the Guidance of

Dr. J. S. Kulkarni

Department Of

ELECTRONICS & TELECOMMUNICATION

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

(SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE)

2024

Project Scheme C

CERTIFICATE

Project Report

On

Project ID: C-02

IoT-Based Wireless EV Charging System for Electric Vehicle

Submitted for Fulfillment of the Requirements for the Degree of Bachelor of Engineering in the Department of Electronics & Telecommunication Engineering, Pimpri Chinchwad College of Engineering, Savitribai Phule University of Pune, Pune.

By

YADNESH LAXMIKANT KOTKAR	**120B1E186**
ATHARVA AMOL KUSURKAR	**120B1E188**
SHRUTI UMAKANT PINGALE	**120B1E203**

Dr. J. S. Kulkarni	**Dr.Rajani.P.K**	**Dr. M.T.Kolte**	**Dr. G. N. Kulkarni**
(Project Guide)	**(Project Coordinator)**	**(H.O.D)**	**(Director)**

Pimpri Chinchwad College of Engineering,
Savitribai Phule Pune University
2024 Scheme C

ACKNOWLEDGEMENTS

All the accomplishments in the world require the effort of many people and this project is no different. Regardless of the source, we wish to express our gratitude to those who have contributed to the success of this project.

We gratefully acknowledge and express heartfelt regards to all the people, who helped us in making the idea of the project, a reality.

We express our gratitude towards **Prof. Dr. J. S. Kulkarni** for her guidance and constant supervision. We would like to express our sincere thanks to **Dr. Rajani. P.K**, Project coordinator and her team for providing necessary information regarding the project time to time & also for their support in completing the project.

We have been lucky to have an H.O.D like **Dr. M. T. Kolte**, whose reviews, comments, corrections & suggestions have enormously enriched our project.

We are also grateful to our principal **Dr. G. N. Kulkarni** for his constant encouragement and support

I am also glad to express my gratitude and thanks to my parents and friends for their constant inspiration and encouragement.

Finally, we express our appreciation & sincere thanks to lab assistance, department of electronics & telecommunication, for their constant involvement at every step in the project which has leaded this project to the path of success.

Yadnesh Kotkar

Atharva Kusurkar

Shruti Pingale

ABSTRACT

The increased popularity of electric cars (EVs) has highlighted the need for a sophisticated and practical infrastructure for EV charging. Traditional cable charging solutions have limits with regard to physical connections, potential hazards, and scalability issues. In order to overcome these obstacles, this study presents a novel method of wireless EV charging that makes use of the Internet of Things' (IoT) capabilities and inductive power transfer (IPT) principles. The power supply unit, the charging station, and the electric vehicle (EV) are the three main components of the suggested system. The main source of electricity is the power supply unit, which transforms grid-supplied AC power into a high-frequency AC signal. Within the charging station, integrated power coils carry out the transmission of this signal. In order to effectively catch transmitted power and ensure successful transfer to the electric vehicle, the charging station has a range of receiving coils that are strategically positioned on the ground.

In addition, the charging station is equipped with Internet of Things features that provide smooth communication and control between the EV, charging station, and power supply unit. The transmitted power is received by the EV, which has a receiving coil. A rectifier and voltage regulator are then used to convert the received power into DC power. Real-time monitoring of the charging process is made possible by the EV's IoT capabilities, which also offer vital information about energy use, battery health, and charging status. This real-time data monitoring and analysis facilitate optimal charging patterns, load balancing, and demand response, thereby optimizing energy resource utilization and mitigating stress on the grid. The amalgamation of IPT and IoT technologies in this wireless EV charging system presents a promising avenue towards efficient, adaptable, and user-friendly EV charging infrastructure.

TABLE OF CONTENTS

Appendix:

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Acronym	**Explication**
WPT	Wireless Power Transfer
EV	Electric Vehicle
SOC	State Of Charge
IOT	Internet of Things
ICSP	In-Circuit Serial Programming
DC	Direct Current
MOS	Metal–oxide–silicon
LCD	Liquid Crystal Display
CMOS	Complementary Metal-Oxide-Semiconductor
RAM	Random-access memory
ROM	Read-Only Memory
AC	Alternating Current
DC	Direct Current
EMC	Electromagnetic Compatibility
IDE	Integrated Development Environment
IPT	Inductive Electricity Transfer
V2G	Vehicle-to-grid

CHAPTER 1

Chapter No. 1

Introduction

In the global landscape of energy distribution, the conventional method of transferring electricity from power stations to various locations relies predominantly on wired infrastructure. The emergence of wireless power transfer technology presents a revolutionary alternative that has the potential to significantly reduce or eliminate the need for traditional wires and batteries. This transformative technology becomes particularly advantageous when interconnecting wires poses challenges such as inconvenience, hazards, or is simply not feasible. Wireless power transfer offers a promising solution to the imminent challenges associated with the extensive use of copper and aluminum metals in electric wires. As these metals face the threat of depletion in the future, the adoption of wireless power transfer technology becomes not only a necessity but a sustainable choice. By minimizing the reliance on traditional electric wires, we can pave the way for a more resource-efficient and environmentally conscious approach to energy transmission. A compelling application of wireless power transfer technology lies in the realm of autonomous vehicle fleets. In scenarios where no human intervention is available to plug in, the ability of autonomous vehicles to drive themselves to a wireless charging spot transforms wireless charging from a mere convenience into an absolute necessity. This underscores the critical role that wireless power transfer can play in advancing the efficiency and autonomy of future transportation systems. This paper aims to delve into the specific application of magnetic resonance-based wireless power transfer technology in charging electric vehicles. It provides an insightful overview of the underlying technology, offering performance data from a state-of-the-art system. Additionally, the paper explores ongoing standardization efforts in the field and addresses the remaining challenges that must be overcome for the widespread adoption of this groundbreaking technology. By focusing on the intersection of wireless power transfer and electric vehicle charging, this research seeks to contribute to the broader conversation on sustainable and innovative solutions in the realm of energy transmission.

1.1. Motivation:

The motivation behind this project stems from the evolving landscape of electric vehicle (EV) technology, which is experiencing a rapid surge in popularity. As the demand for EVs continues to grow, the necessity for efficient and user-friendly charging infrastructure becomes increasingly evident.

The current state of affairs in EV charging stations primarily involves physical connections through cables, which possess inherent limitations in terms of user convenience, varying charging standards, and compatibility issues. Addressing these limitations, the endeavor to develop wireless EV charging technology emerges as a compelling solution.

This project is motivated by the potential benefits that wireless charging offers, such as the ease of use without physical plugging, the promising prospect of automatic charging, and the elimination of dependency on charging cables. By exploring and advancing IoT-based wireless charging systems, the project aims to augment the existing EV ecosystem. This innovation intends to provide drivers with diverse and convenient charging options, both at home and on the go, thereby fostering the seamless integration of electric vehicles into everyday transportation while overcoming the constraints of traditional charging methods.

Enhanced Convenience: Users may find it cumbersome to use traditional plug-in charging methods for EVs because they necessitate physical connections through wires. Drivers can benefit from increased convenience as IoT-based wireless charging does away with the need for cords. Users may park their cars over wireless charging pads that are placed on the ground to start the charging process, saving them the trouble of constantly connecting and unplugging wires.

Future-Forward Technology: With the automotive sector moving towards electric vehicles, it is essential to provide cutting-edge and creative infrastructure for charging them. The cutting-edge and future technology of Internet of Things-based wireless EV charging is in line with the changing demands of electric car owners.

seamless combination of IoT devices: Automated and intelligent charging procedures are made possible by integrating IoT capabilities into wireless EV charging systems. Through communication with the onboard computer of the car, the Internet of Things-enabled technology allows for real-time charging status monitoring, rate adjustments, and efficiency optimization.

1.2. Background:

The traditional paradigm for transmitting electricity mostly depends on wired infrastructure, which is a system deeply ingrained in the world's energy supply. Although wired transmission has been shown to be efficient and reliable, situations in which connecting wires is unsafe, impractical, or not feasible present difficulties like inconvenience, risks, and logistical limitations. Furthermore, there are worries about resource depletion in the near future due to the widespread usage of copper and aluminum metals in electric cables.

The investigation of wireless power transfer technology has grown in importance as a result of the realization of the drawbacks and environmental effects of wired transmission. This creative method presents a game-changing answer by imagining a time when reliance on conventional wiring and batteries is drastically decreased or perhaps completely removed.

With the need for energy growing, it is more important than ever to decrease dependency on copper and aluminum, two limited commodities. Adopting wireless power transfer technology is in line with sustainable practices and promotes itself as an essential component of an energy transmission system that is more ecologically sensitive and efficient.

Apart from these general points, the emergence of fleets of autonomous vehicles presents a strong application case for wireless power transmission. When cars are not plugged in by humans, technology becomes more than just a convenience—it becomes essential. The capacity of self-driving cars to find wireless charging locations highlights how wireless power transmission has the opportunity to completely change the way transportation infrastructure is built.

The employment of wireless power transmission technology based on magnetic resonance in the charging of electric vehicles is the special focus of this project. Through providing an outline of the underlying technology, showcasing performance data from a cutting-edge system, evaluating standardization efforts, and outlining unresolved issues, this study adds to the growing conversation about creative and sustainable energy transmission solutions. With the world heading toward a technologically advanced future, this project seeks to be a major player in determining the direction of wireless power transfer technology and how it is used in electric vehicle charging infrastructure.

CHAPTER 2

Chapter No. 2

Literature Survey

2.1. Literature Survey Table

Sr. No.	Title of the Paper	Year of Publication	Publisher	Methodology	Conclusion
1	Iot-Based Wireless EV Charging System for Electric Vehicle Using Inductive Power Coils.	2023	International Journal of Current Science (IJCSPUB)	The methodology involves the strategic installation of charging components, the implementation of inductive power transfer techniques for efficient energy transmission, and the integration of an ESP32 module for comprehensive real-time monitoring and feedback provision throughout the charging process.	EVs are crucial in the quest for alternative energy sources to cut down carbon emissions in public transportation. Wireless charging devices simplify the EV charging process, offering an effective and user-friendly option. Simulation results affirm the efficacy of non-radiative wireless power transmission, displaying high efficiency rates at specific distances.

2	IoT-Based Electric Vehicle Charging Station	2022	International Research Journal of Engineering and Technology (IRJET)	QR Code Scanning and Port Selection: EV owners use an Android app (Java, XML) to scan a QR code above the charging port for selection and balance check. Charging Timeout Suggestion: The app recommends an EV charging duration based on the user's wallet balance. Communication Cable Verification. Charging Initiation: After successful checks, charging starts for the EV.	The system's goal is an automated charging station managed through an Android app, prioritizing user ease and efficient operations. It emphasizes internet-controlled functions and simple payment methods via the app for seamless user experiences. Users can manage charging preferences and payments effortlessly, fostering a worker-free system resembling petrol pumps. Subscription validation via communication cables ensures authorized access, while future considerations include potential bidding processes for EV user allocation, aiming for continual system enhancement.

3	Charging Station of Electric Vehicle Based on IoT: A Review	2022	Open Access Library Journal	To facilitate the comparison of different techniques, SoC in real-time have been shown. These have been categorized into four classes, as briefly discussed below. Looking-Up Table-Based Techniques An Ampere-Hour Integral Technique The Model-Based Estimation Techniques	Electric vehicles play a crucial role in addressing fuel scarcity and curbing environmental pollution. Accessible charging stations, facilitated by IoT and Internet technologies, minimize travel time for users. Displaying SOC via apps optimizes energy consumption, extending battery life for efficient usage. Station placement in parking areas maximizes convenience, while integrating solar and wind energy diversifies sustainable charging options beyond the primary grid.
4	A Review on IoT based Electric Vehicle Charging and Parking System	2020	International Journal of Engineering Research & Technology (IJERT)	The mobile app bolsters parking security by sharing slot information and integrating seamlessly with	This paper compares smart parking, charging, and combined charging-parking systems, addressing related

				existing infrastructure. Leveraging GPS and automated data generation, the system independently schedules EV charging, reducing errors and time consumption. Implementing a Charging Management System streamlines operations, and wireless charging offers efficiency over traditional plug-in methods while enabling convenient slot bookings.	issues. It includes a comparative table of research papers and discusses various methods, sensors, controllers, and cloud servers for automatic, reliable, and user-friendly systems. The focus is on developing an efficient Internet of Things (IoT) platform.
5	IoT Based Electric Vehicle Charging Station System	2022	Grenze International Journal of Engineering and Technology	The Arduino-run system detects EVs using IR sensors, controlling gate access via a servo motor based on slot availability. Upon	This project explores an IoT-based EV charging system, focusing on architecture, charging methods, and key elements like sensors, LCD display, Node

				EV arrival, it showcases Battery State of Charge (SOC) on an LCD and Android app, employing NodeMCU, I2C LCD driver, and IR sensors for automated entry/exit updates. NodeMCU and servo motors manage gate operations while IR sensors update slot statuses on the LCD display during EV entry.	MCU, and cloud integration. It aims to enhance EV charging by offering real-time slot availability and State of Charge (SOC) updates via an LCD display and Android app, streamlining the user experience. The primary goal is to develop an efficient Android app dedicated to monitoring battery SOC, reducing search time for charging stations and slot availability.

2.2. Summary of Literature Survey

The IoT-Based Wireless EV Charging System for Electric Vehicles demonstrates a promising avenue for efficient and user-friendly charging infrastructure. Through strategic installation of charging components and implementation of inductive power transfer techniques, this system offers a seamless charging experience. The integration of an ESP32 module ensures comprehensive real-time monitoring and feedback provision throughout the charging process, emphasizing the importance of efficient energy transmission and user convenience. As electric vehicles emerge as pivotal alternatives in reducing carbon emissions, the system's wireless charging devices simplify the charging process, signifying a step towards a sustainable transportation future. Further optimization and advancements in IoT-based charging systems hold significant potential in revolutionizing the electric vehicle charging landscape for widespread adoption and environmental benefit.

2.3. Gap Identified through Literature Survey

The literature survey has revealed several notable gaps and opportunities within the domain of IoT-based Electric Vehicle (EV) charging systems. Despite advancements, there is a discernible need for standardized protocols and increased interoperability among different charging infrastructure components, fostering a more unified and efficient charging ecosystem. Additionally, while user-friendly features such as QR code scanning and mobile apps have been integrated, a gap exists in tailoring solutions to diverse user needs and preferences, encompassing individuals with varying technical proficiencies and accessibility requirements. Further exploration into the energy efficiency of IoT-based EV charging systems, including the optimization of energy consumption and the integration of renewable sources, remains an avenue for future research. Security and privacy concerns related to data protection and secure communication in IoT-enabled charging infrastructure require more in-depth examination. Moreover, understanding the scalability and cost-effectiveness of large-scale IoT deployment for EV charging, as well as exploring the integration of these systems with smart grids for enhanced grid management, are essential aspects to be addressed. Bridging these identified gaps is crucial for advancing the robustness, user-centricity, and sustainability of IoT-based EV charging systems.

2.4. Problem Statement

The necessity for effective and practical charging infrastructure has arisen from the explosive expansion of electric cars (EVs) in recent years. Conventional plug-in charging techniques have drawbacks in terms of physical connector wear and tear, possible safety risks, and user convenience. Inductive power coil-based wireless charging systems have surfaced as a viable remedy for these issues. Nevertheless, there are a number of issues that need to be resolved when integrating Internet of Things (IoT) capabilities with inductive power coil-based wireless EV charging systems.

2.4.1. Aim

Examine Wireless Power Transfer: Learn about the potential of this technology by focusing on how it can be used to charge electric vehicles (EVs). You should also try to figure out the basic ideas behind it and how it differs from conventional cable infrastructure.

Analyze Performance and Standards: To understand the present situation and potential future developments, analyze the performance of magnetic resonance-based wireless power transfer systems as well as the ongoing standardization initiatives in the industry.

Key Challenges: Determine and address the issues that are still preventing wireless power transmission for EV charging from being widely used. These issues include efficiency, safety, interoperability, and regulatory concerns. By doing so, you may offer practical advice for getting beyond implementation roadblocks.

Contribute to Sustainability: Emphasize how wireless power transfer helps the environment by lowering dependency on limited resources like copper and aluminum and encouraging resource efficiency in the transmission of energy, both of which are in line with more general sustainability objectives.

To improve user experience and system efficiency, investigate how wireless EV charging systems can be integrated with IoT capabilities to provide seamless integration. This includes automated and intelligent charging procedures, real-time monitoring, and optimization.

2.4.2. Objectives

- To create a charging station capable of accommodating two electric vehicles simultaneously, thereby increasing charging capacity and efficiency to meet the growing demand for electric vehicle charging infrastructure.
- To integrate a user-friendly mobile application interface that allows users to remotely monitor, manage, and schedule charging sessions, providing convenience and flexibility while ensuring optimal utilization of charging resources.
- To implement power-saving mechanisms within the charging station, such as intelligent power management and scheduling algorithms, aimed at optimizing energy consumption and reducing environmental impact during the charging process.
- To develop and incorporate auto-detection technology that can automatically identify and adjust charging parameters based on the specific requirements of different electric vehicle models, ensuring compatibility and enhancing user experience.

CHAPTER 3

Chapter No. 3
Methodology

3.1. Project Outline

Wireless electric vehicle (EV) charging technology utilizes Inductive Power Transfer (IPT) to transfer power between two coils: a primary coil at the charging station and a secondary coil installed in the EV. This method enables convenient and cable-free charging by creating an alternating magnetic field between the coils.

The process begins with the positioning of coils beneath specially marked parking slots, ensuring effective energy transfer when an EV parks over the designated area. High-frequency energy is then transmitted through the wireless charging station, generating alternating magnetic fields that induce electricity transfer to the EV's coils.

Once the induced electricity is received, it is converted from AC to DC using a rectifier and directed towards the vehicle's battery for charging. This process replenishes the battery's energy storage, keeping the EV powered and operational.

Two main types of IPT are employed for wireless charging: Static IPT for parked vehicles and Dynamic or Quasi-dynamic IPTs for charging while in motion or briefly stopped, such as at traffic lights. Wireless charging provides a practical solution for dynamic or quasi-dynamic charging, as wired charging is not feasible while EVs are in motion.

Stationary charging involves transferring AC through a coil in the charging plate to the car's inductive 'pick-up,' while dynamic charging allows for charging while the vehicle is in motion. Charging lanes embedded with wireless chargers alongside roads enable drivers to charge their vehicles while driving, enhancing the convenience and accessibility of EV charging infrastructure.

Overall, wireless EV charging offers a seamless and effective method for charging electric vehicles, emphasizing the smooth connection between the vehicle and the charging station to facilitate convenient charging experiences.

3.2. Block Diagram Explanation

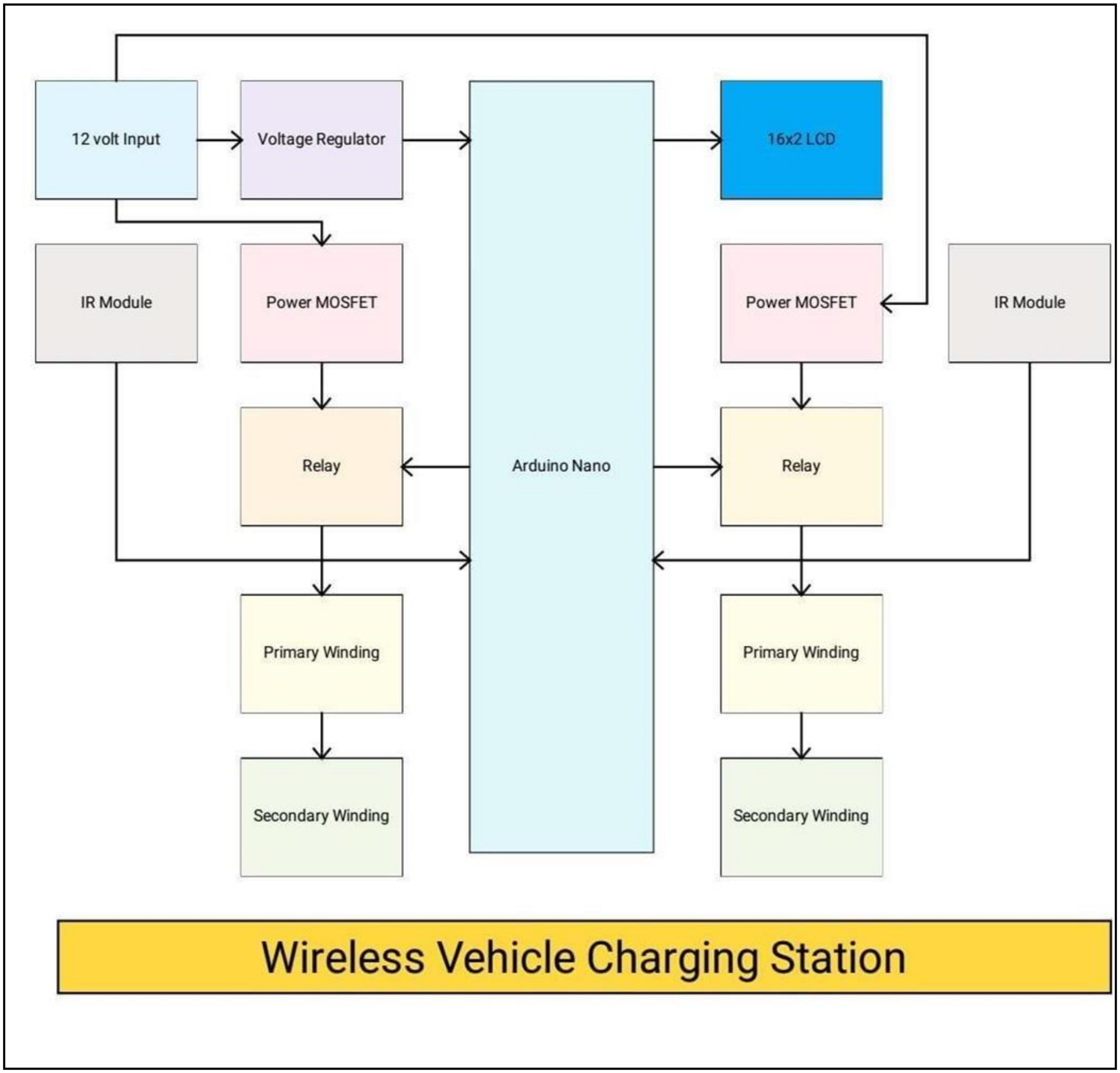


Fig:3.2 Block Diagram of Wireless Vehicle Charging station

3.2.1. Explanation:

Electric vehicles that wish to charge wirelessly must first park their cars over a specially marked slot that has been outfitted with the necessary equipment. This wireless charging conduit is created by carefully placing coils beneath this parking lot to create an alternating magnetic field. The electric car is equipped with coils underneath the charging station at the same time. The synchronization of these coils with the wireless charger occurs when the car parks over the preset place, guaranteeing effective energy transfer. High-frequency energy is sent through the wireless charging station once it is aligned, producing alternating magnetic fields close to the coils positioned under the parking space. The electric energy from the charging station is transferred to the electric car through the coils installed into the vehicle as a result of these alternating magnetic fields. The induced electricity is then converted by means of an AC-DC converter, also known as a rectifier, into direct current (DC) in order to meet the battery requirements of the vehicle.

After being converted to DC electricity, the electricity is routed towards the vehicle's battery and used to charge it. The electric car is kept powered and operational by this process, which replenishes the battery's energy storage. Overall, the block diagram shows a thorough and effective way to charge electric cars wirelessly, highlighting the smooth connection between the car and the charging station to enable convenient, cable-free charging.

Functions of block:

1. **Relay Module**

Relays, which are electrically operated relays, can be turned on or off by means of this controlled device's opening and closing. Relays can be made up of a set of working contact terminals and a set of input terminals for one or more control signals. Multiple contact types, such as make, break, and combination contacts, can be present in any number of relays. Relays equipped with low pass signals can be used to control the circuit, or multiple circuits can share a single signal. Relays are used in long-distance telegraph systems as signal repeaters because they can receive signals from one circuit and send them to another.

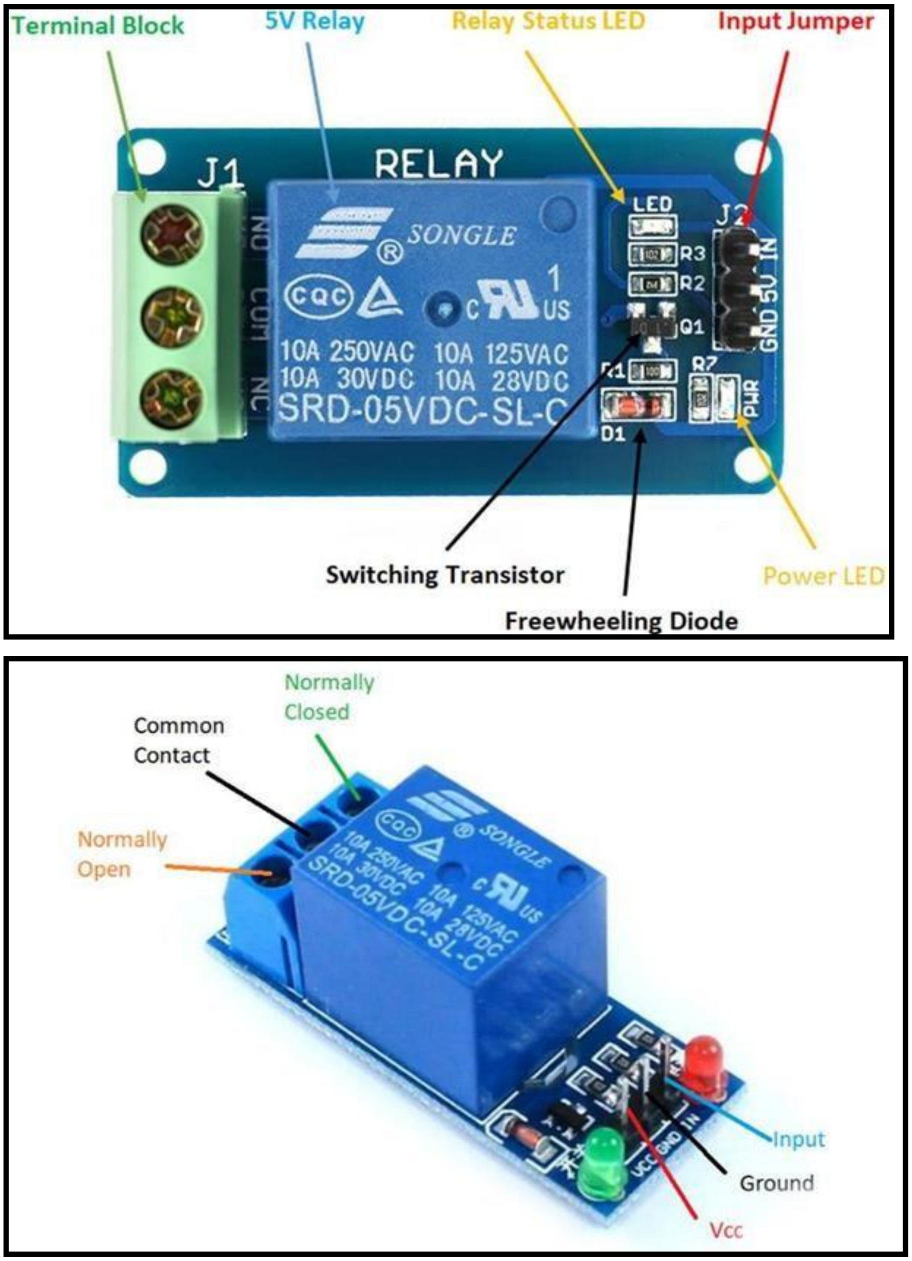


Fig:3.2.1 Relay Module

Parts of a 5V Single Channel Relay Module The main parts of a relay module are as follows; we shall go into more detail later in this post. 5V relays, 3-pin screw-type terminal connectors, male header pins, resistors, LEDs, and diodes, among other components.

How to Use a Single-Channel Relay Module: Mains loads are typically driven by sensors or microcontrollers such as Arduinos using relay modules such as this one. In situations such as this, the typical circuit diagram might look like this.

A Relay Switched Mains Powered Load Comes in Two Variations:

It is possible to connect the relay as previously explained for basic on/off applications. Depending on whether the load is present, one mains terminal is connected to common and the other to either NO or NC depending on whether the load should be connected or disconnected when the relay is active.

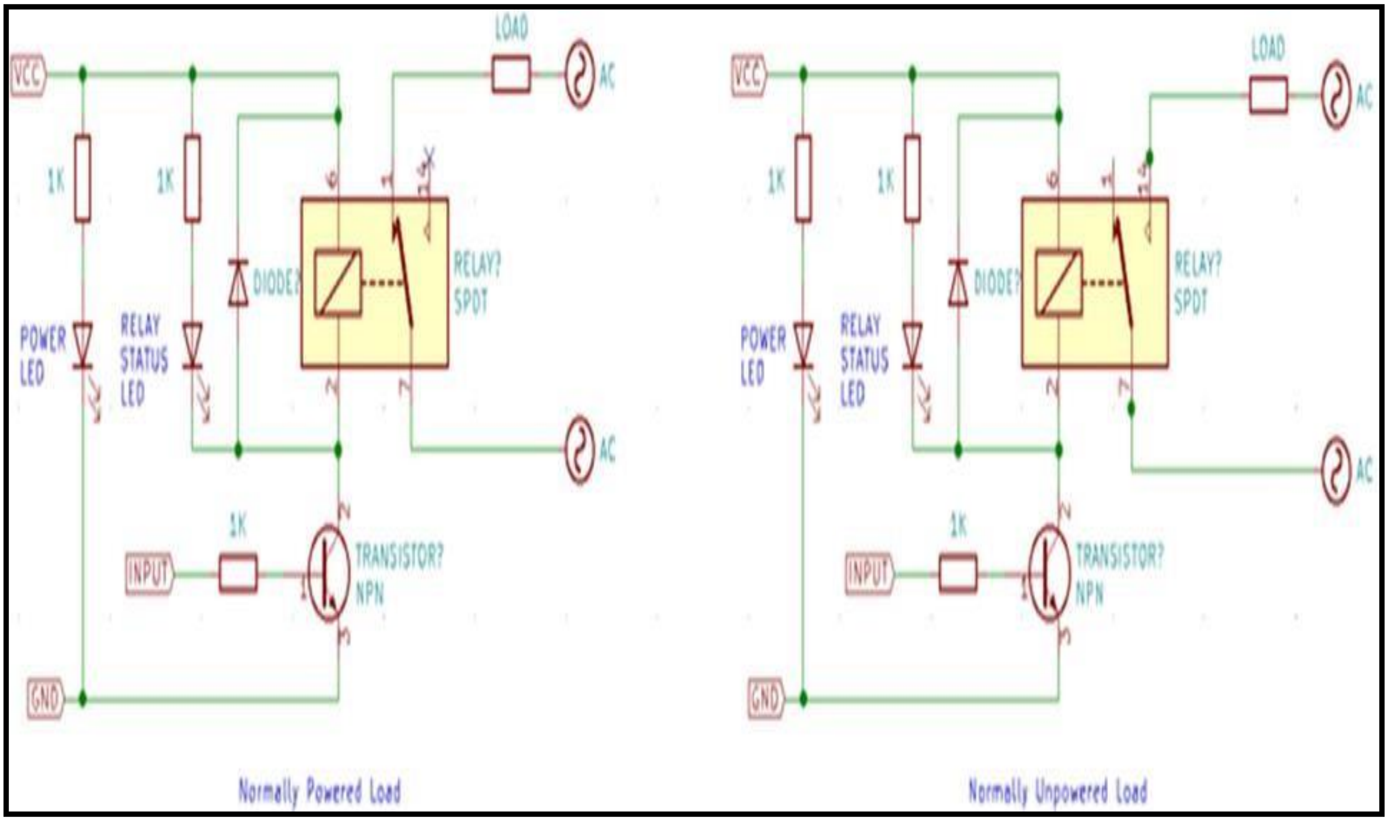


Fig:3.2.2 Two Variations of A Relay Switched Mains Powered Load

2. Arduino Nano

The Arduino IDE and circuit boards can read analog or digital input data from various sensors, turn on and off LEDs, activate motors, and do a host of other similar tasks. By sending a set of instructions to the ATmega328 main microcontroller via the Arduino IDE, the tiny Arduino Nano can perform all of its functions. The Arduino board also has 14 digital input/output pins, Aref, Arduino reset, power USB, voltage regulator, crystal oscillator, voltage pin (3.3v,5v,gnd,Vin), A0 to A5 analog pins, ices pin, power led indication, Tx Rx leads, and 14 digital input/output pins. The Arduino project began as a program in 2003.

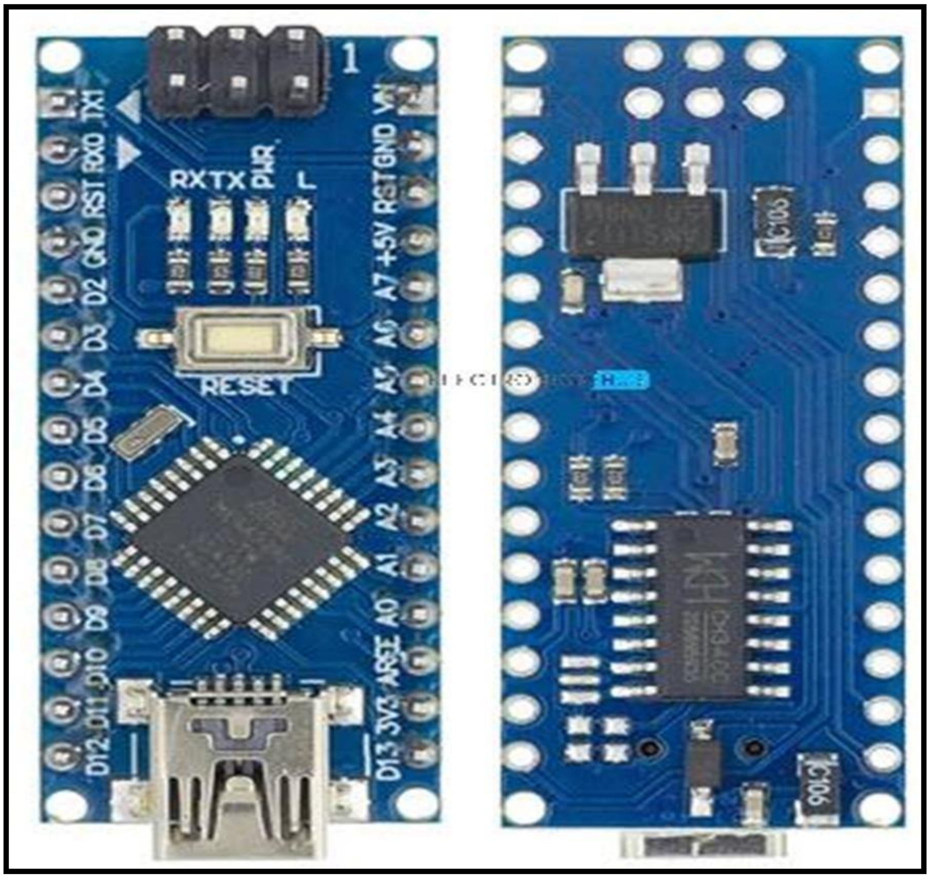


Fig:3.2.3 Front and Back view of Arduino Nano Board

Arduino Nano Board Layout

The following image shows the layout of a typical Arduino nano board. As you can see from the previous image, there are a couple of components on the bottom side of the board as well (5V Regulator and USB-to-Serial Converter IC are the main ones).

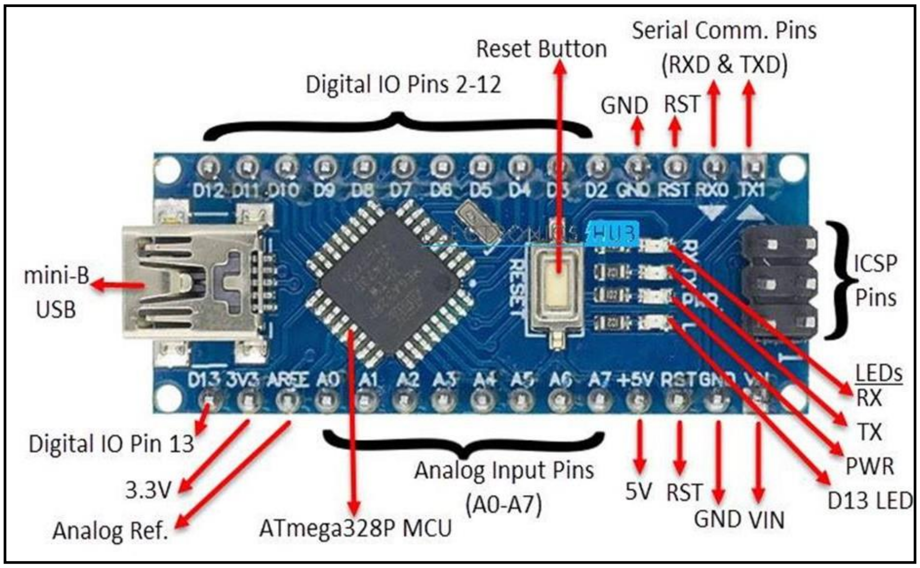


Fig:3.2.4 Arduino Nano Board Layout

A mini-B type connector is used in place of the Arduino UNO's Type-B USB connector. Additionally, there isn't a 2.1 mm DC connection for an external power source. Aside from that, the Arduino Nano's layout is highly self-explanatory.

Qualities:

Digital IO pin 13 is coupled to an on-board LED. To make this LED blink, use it as an LED. By default, the inbuilt ADC's reference voltage is set at 5V. However, you can manually set the ADC's higher limit by using the AREF pin. Using the on-board RESET button, you can reset the microcontroller. While the Arduino Nano can be programmed via the USB wire, the MCU can also be programmed via the In-Circuit Serial Programming (ICSP) interface.

The ATmega328P microcontroller is pre-loaded with the UART bootloader, which allows serial interface programming. However, no bootloader is required for ICSP. You can use the Arduino Nano's ISCP to program other Arduino Boards, or you can program the Arduino Nano using ISCP. External Interrupts Pins INT0 and INT1, respectively, can be set for Digital IO Pins 2 and 3.

Configure the interrupt for a rising edge, falling edge, or level change on the pin by using the attach Interrupt() function.

3. MOSFET :

The metal-oxide–semiconductor field-effect transistor (MOSFET, MOS-FET, or MOSFET), sometimes referred to as the metal–oxide–silicon transistor (MOS transistor, or MOS), is a kind of insulated-gate field-effect transistor that is created by carefully oxidizing a semiconductor, usually silicon. The electrical conductivity of the device is determined by the voltage of the covered gate; this property can be utilized to switch or amplify electronic signals based on the voltage applied.

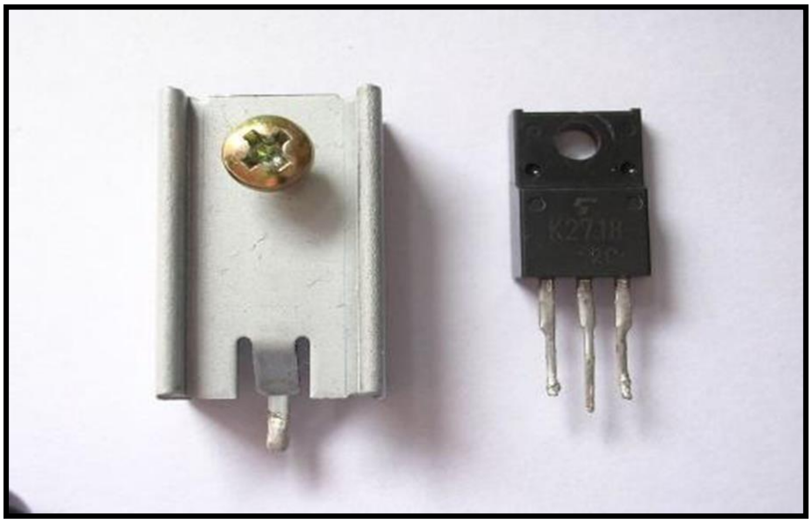


Fig:3.2.5 MOSFET

Working Principle of MOSFET:

The capability of the MOSFET device to regulate the voltage and current flow between the source and drain terminals is its fundamental function. It functions similarly to a switch, and the MOS capacitor is what powers the gadget. The MOSFET's primary component is the MOS capacitor. Positive or negative gate voltages can be applied to the semiconductor surface at the bottom oxide layer, which is situated between the source and drain terminals, to change its p-type to n-type configuration. Applying a repulsive force to the positive gate voltage causes the holes in the oxide layer to be pushed downhill along with the substrate.

The depletion area is inhabited by bound negative charges connected to the acceptor atoms. A channel forms when electrons are attained. Electrons from the n+ source and drain regions are also drawn into the channel by the positive voltage.

Presently, the current flows freely between the source and drain if a voltage is supplied between them, and the gate voltage regulates the electrons in the channel. If a negative voltage is applied in place of the positive voltage, a full channel will form beneath the oxide layer.

Application of MOSFET as a Switch:

The automatic brightness control feature of street lights is one of the most notable applications for this technology. High-intensity discharge lamps make up a large portion of the lights we see on roadways these days. However, HID light use results in higher energy consumption.

Because the brightness cannot be restricted in accordance with the specifications, an LED switch for an alternate lighting approach must be present. The drawbacks of high-intensity lighting can be avoided by utilizing an LED system. This was built with the primary idea of using a microprocessor to directly control the lights on roadways.

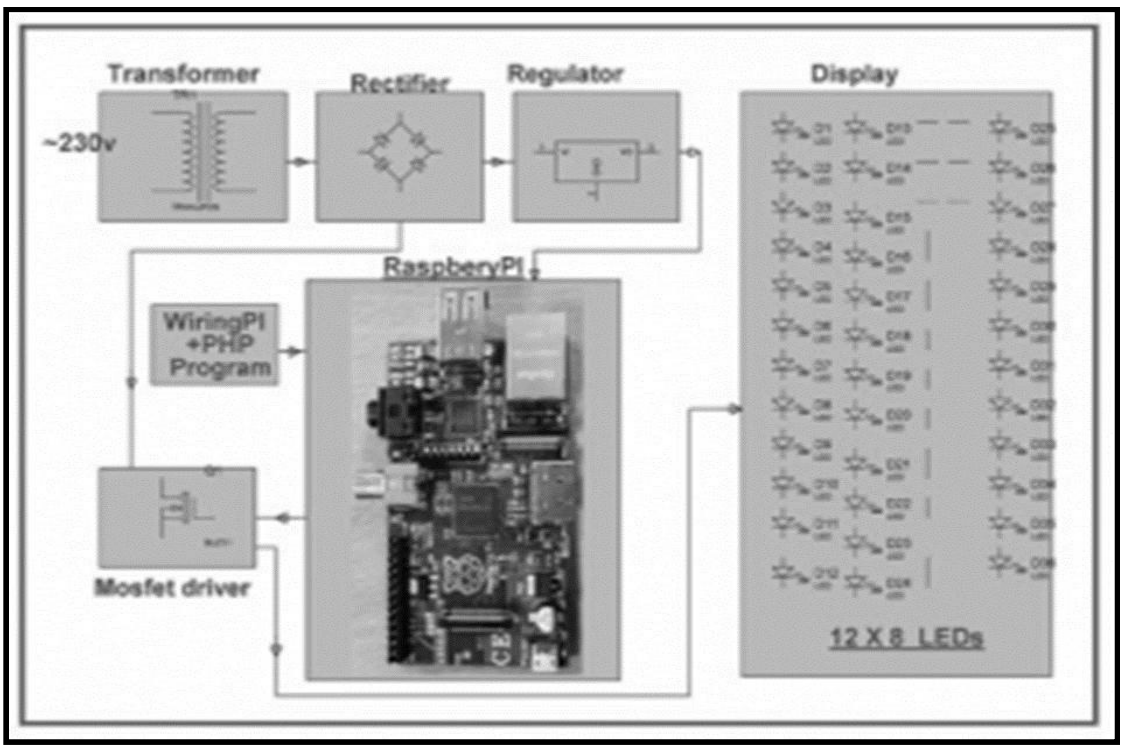


Fig:3.2.6 MOSFET as Switch

Advantages:

- Enhanced Efficiency at Minimal Voltage Levels: One of the key advantages of these devices is their ability to achieve enhanced efficiency even when operating at minimal voltage levels.
- Absence of Gate Current: These devices exhibit no presence of gate current, resulting in higher input impedance. This characteristic contributes to increased switching speed for the device.
- Minimal Power Consumption: Another advantage is that these devices can function efficiently at minimal power levels and require minimal current to operate.

Disadvantages:

- Instability at Overload Voltage Levels: When these devices are subjected to overload voltage levels, they may experience instability, which can affect their performance and reliability.
- Vulnerability to Damage from Electrostatic Charges: Due to the presence of a thin oxide layer, these devices may be susceptible to damage when exposed to electrostatic charges, posing a potential risk to their longevity and functionality.

4. IR Sensors:

An infrared sensor is an electrical device that produces light to detect an object in its environment. In addition to detecting motion, an infrared sensor may measure an object's temperature. Typically, all items emit some kind of thermal radiation in the infrared range. Although these radiations are undetectable to the human eye, they can be detected by infrared sensors.

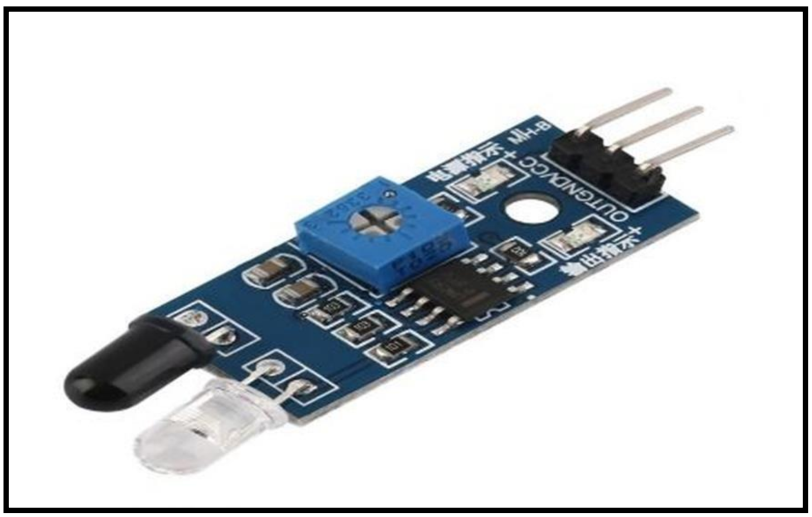


Fig:3.2.7 IR Sensors

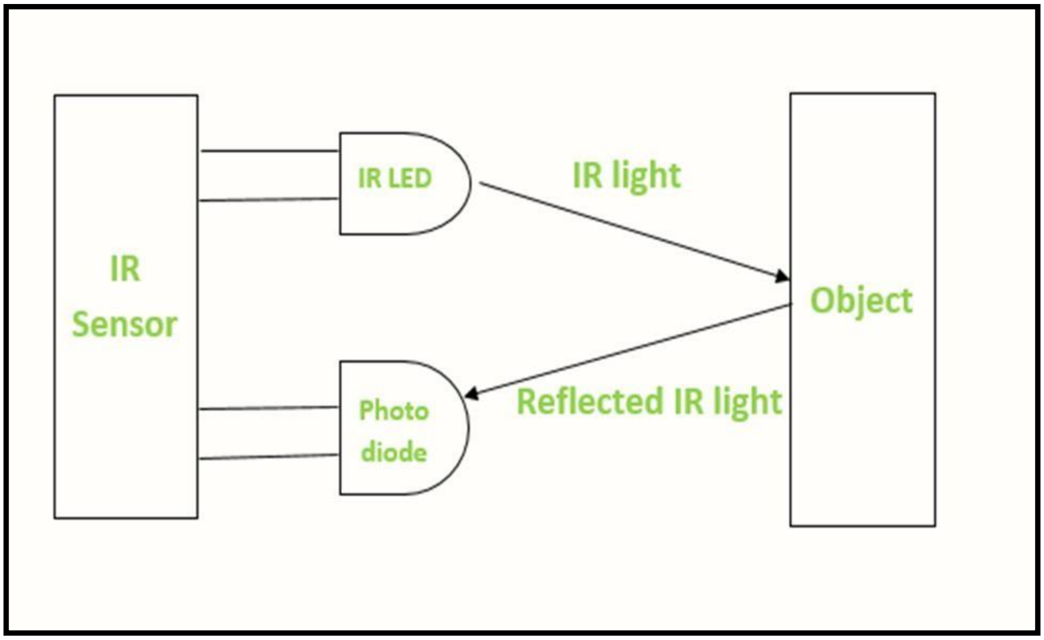


Fig:3.2.8 Working Principle of IR Sensors

IR Sensor Applications:

1. Night Vision Devices: Infrared (IR) sensors play a crucial role in night vision systems, enabling the detection of infrared radiation emitted by objects in low-light or dark environments. These sensors enhance visibility and enable surveillance and navigation in conditions where visible light is insufficient.
2. Radiation Thermometers: IR sensors are utilized in radiation thermometers to measure the temperature of objects by detecting the infrared radiation they emit. This application finds use in various industries, including manufacturing, healthcare, and food processing, for non-contact temperature measurement purposes.
3. Infrared Tracking: Tracking systems utilize infrared signatures captured by IR sensors to track and identify individuals or objects. This technology is commonly employed in security and surveillance contexts, enabling monitoring and tracking of movements in both indoor and outdoor environments.
4. Meteorology and Climate Monitoring: In climatology and meteorology, IR sensors are employed to monitor atmospheric conditions. By detecting the infrared radiation released by clouds, water vapor, and other atmospheric components, these sensors provide valuable data for weather forecasting, climate studies, and environmental monitoring applications.

5. LCD:

An LCD (Liquid Crystal Display) screen serves as an electronic display module with a wide array of applications. Among the various LCD modules available, the 16x2 LCD display stands out as a basic yet extensively utilized module across diverse devices and circuits. These modules are favored over alternatives like seven segments and multi-segment LEDs for several reasons: LCDs are cost-effective, programmable with ease, and offer flexibility in displaying special or custom characters, animations, and more.

The term "16x2 LCD" denotes its capacity to display 16 characters per line, with 2 such lines available. Each character is presented within a 5x7 pixel matrix on this type of LCD. Additionally, these LCDs feature two registers: the Command register and the Data register. Equipped with a built-in HD44780 equivalent LCD controller, they seamlessly interface with microcontrollers such as ATMEGA, ARDUINO, PIC, and various other microcontroller kits.

Utilizing CMOS technology, these devices boast low power consumption, rendering them suitable for applications requiring handheld, portable, or battery-operated instructions. This efficiency makes them ideal for a wide range of electronic projects and devices where energy efficiency is paramount.

Fig:3.2.9 LCD display 16X

Features:

Drive method: 1/16 duty cycle

Display size: 16 character * 2 lines

Character structure: 5*8 dots.

Display data RAM: 80 characters (80*8 bits)

Character generate ROM: 192 characters

Character generate RAM: 8 characters (64*8 bits)

Both display data and character generator RAMs can be read from MPU.

Internal automatic reset circuit at power ON.

Built in oscillator circuit.

Table :3.2.1 Table 1 Pin description of LCD Bus

JP1/JP14 Pins 1 – 8	Description	JP1/JP14 Pins 9 -16	Description
Pin1	Ground	Pin9	D2 (Not Used)
Pin2	VCC (+5)	Pin10	D3 (Not Used)
Pin3	Contrast	Pin11	D4
Pin4	Data/Command (R/S)	Pin12	D5
Pin5	Read/Write (W)	Pin13	D6
Pin6	Enable (E1)	Pin14	D7
Pin7	D0 (Not Used)	Pin15	VCC (LEDSV+)
Pin8	D1 (Not Used)	Pin16	Ground

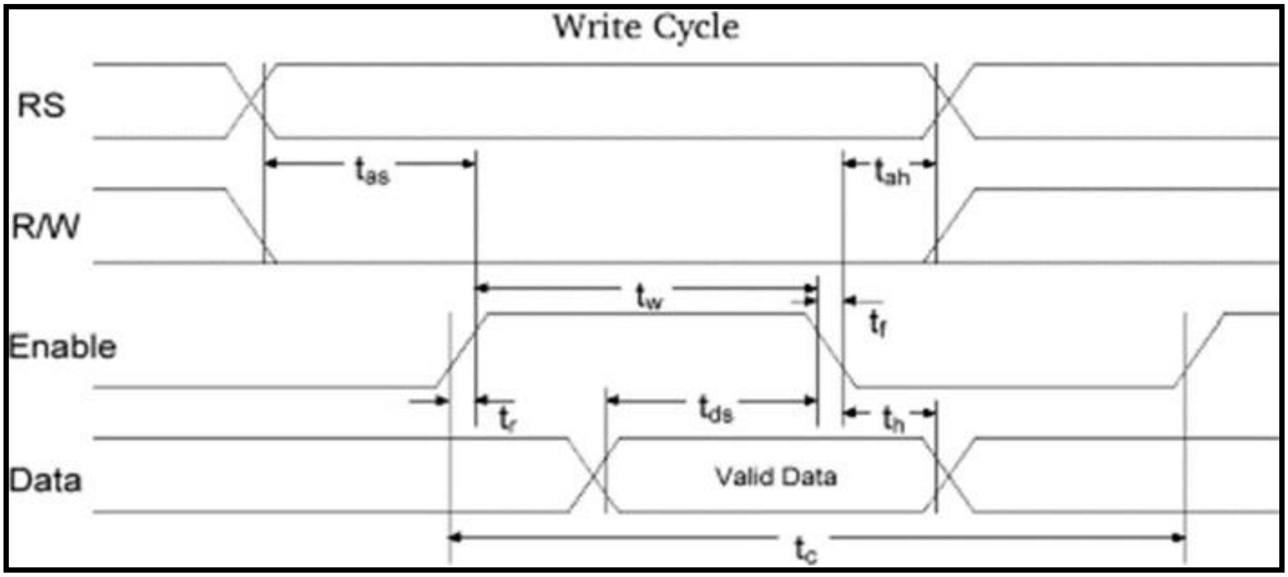


Fig:3.2.10 Timing Characteristics

CHAPTER 4

Chapter No. 4

Design & Implementation of Proposed System

4.1. Circuit Diagram

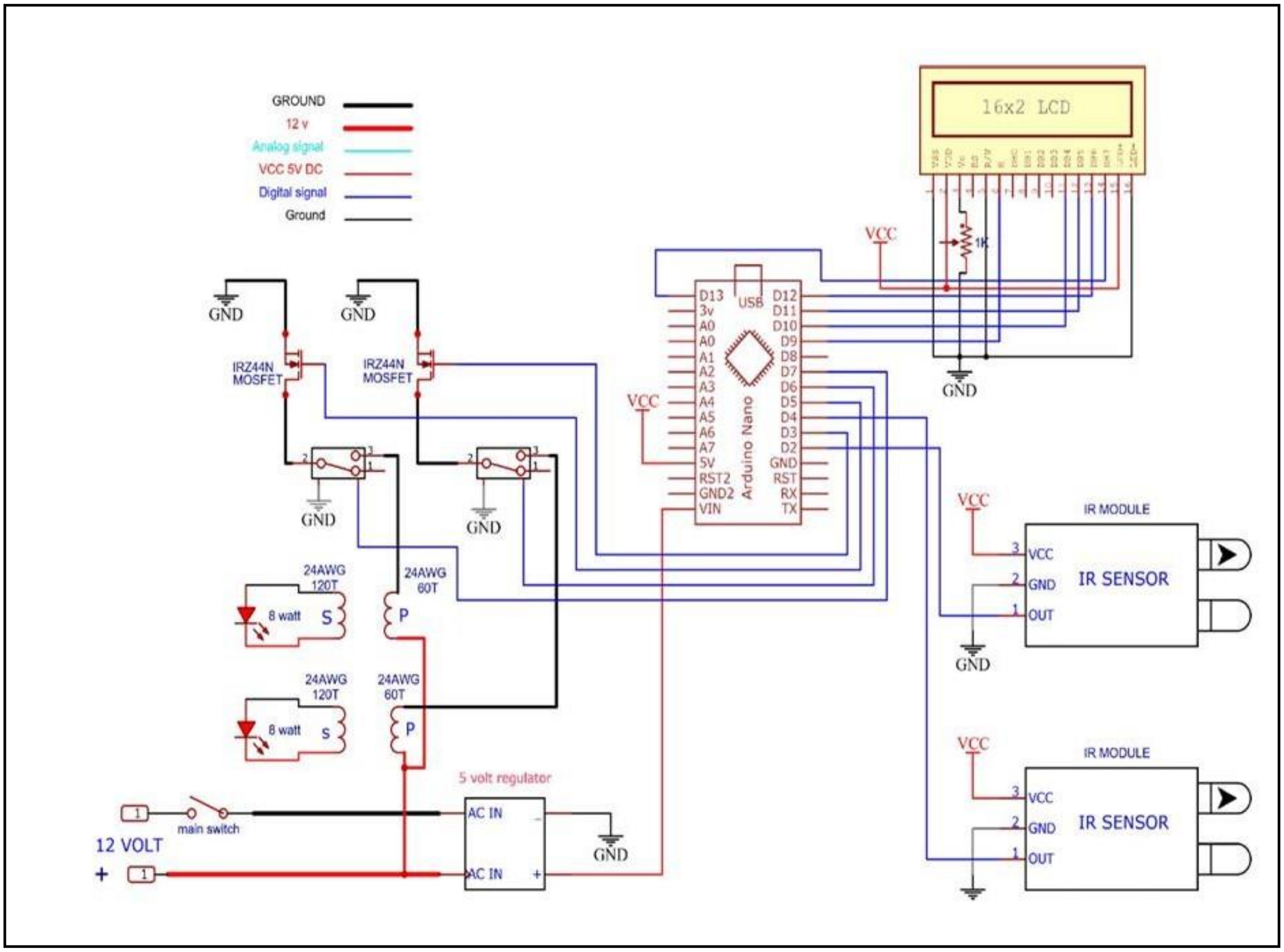


Fig:4.1 Circuit Diagram of Wireless EV Charging System for Electric Vehicle

4.1.1. Circuit Function

The circuit diagram depicted in the figure illustrates an electric vehicle (EV) charging system, with the microcontroller serving as its central component. Utilizing an Arduino Uno processor, the system is implemented with programming written in Embedded C. Various sensors depicted in the figure play critical roles in the system's operation.

The Current sensor is employed to measure the current flowing through a wire, generating a signal proportional to the current. This output signal can be utilized to display the measured current using an ammeter or for further analysis. Another essential sensor is the Voltage Sensor, which converts measured voltage into a physical signal proportional to the voltage. Notably, it can detect the presence of voltage without making metal contact. This sensor employs a resistive voltage divider and integrated resistors embedded in a casted resin, which exhibits low inductance. The resin's permittivity also acts as a capacitance, enhancing the sensor's functionality.

The Arduino Uno microcontroller board, based on Microchip ATmega328P, is equipped with analog and digital input/output pins, facilitating connections to various extension boards and circuits. The microcontroller governs the functions of the connected devices as per the system's requirements.

Working Mechanism:

Wireless EV charging operates on Inductive Power Transfer (IPT) technology, which involves transferring power between two coils: a primary coil at the wireless charger connected to the electrical grid, and a secondary coil located at the EV. The primary and secondary coils are positioned with a reasonable air gap between them, enabling energy transfer via magnetic induction. A transmitting coil in the wireless charger generates a magnetic field that induces energy transfer to a nearby receiving coil on the EV. The efficiency of power transfer depends on the coupling between the coils and their quality factor.

There are two main types of IPT for wireless charging: Static IPT, used when the vehicle is parked, and Dynamic or Quasi-dynamic IPTs, utilized when the vehicle is in motion or briefly stopped, such as at traffic lights. Wired charging is impractical while EVs are in motion, making WPT the only solution for dynamic or quasi-dynamic charging.

Stationary charging involves transferring alternating current (AC) through a coil in the charging plate via a magnetic field to the car's inductive 'pick-up.' A voltage converter in the car converts the AC into direct current (DC), charging the battery pack. A charging pad is placed on the ground, connected to a wall-mounted power adapter. When the charger detects the receiver within range, it automatically starts charging.

Dynamic charging is similar to stationary charging, but the vehicle can be charged while moving on the road. Charging lanes embedded with wireless chargers are provided alongside roads, allowing drivers to charge their vehicles while driving. Wireless chargers are embedded in the road surface at regular intervals. Electric buses equipped with wireless charging receivers can automatically charge when stopped over these chargers. This technology has been tested in various countries, including the UK, Italy, the Netherlands, and South Korea.

4.2. Hardware specification

1. Relay Module

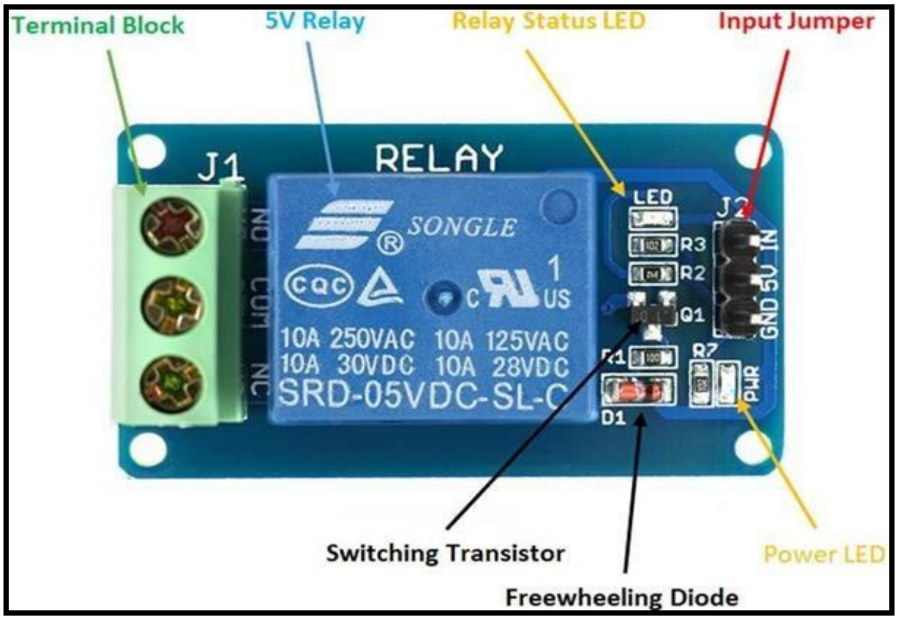


Fig 4.2.1 Relay Module

Table 4.2.1 Hardware specifications of 5 Channel Relay Module

1. Normal voltage: 5V DC
2. Normal current: 70mA
3. Maximum load current: 10A/250V AC, 10A/30V DC
4. Maximum switch voltage: 250V AC, 30V DC
5. Operate time: ≤ 10ms
6. Release time: ≤ 5ms

2.ESP32

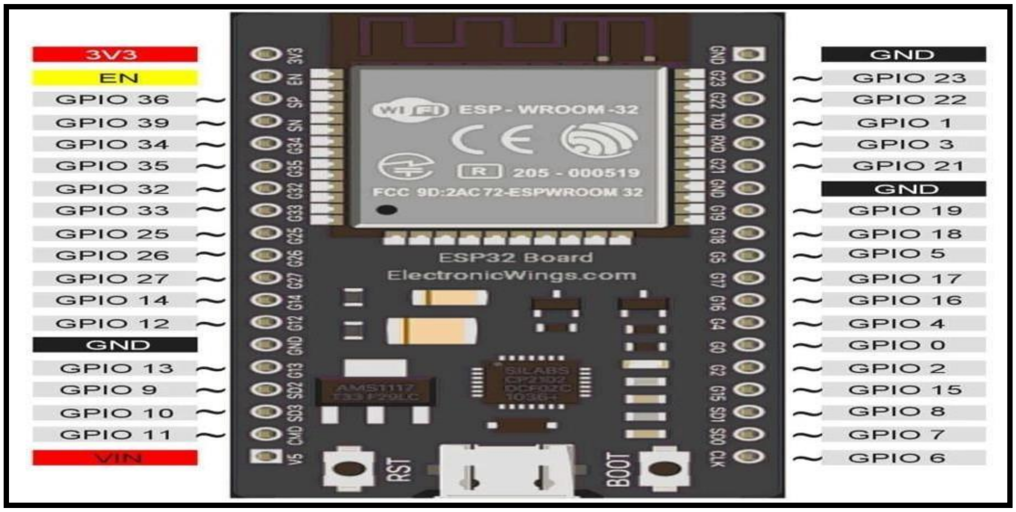


Fig 4.2.2 ESP 32

Table 4.2.2: Hardware Specifications of ESP32 Module

1. Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240MHz.
2. 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
3. Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
4. Support for both Classic Bluetooth v4.2 and BLE specifications.
5. 34 Programmable GPIOs.
6. Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
7. Serial Connectivity includes 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART.
8. Ethernet MAC for physical LAN Communication (requires external PHY).
9. 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.Motor PWM and up to 16-channels of LED PWM.

Secure Boot and Flash Encryption.

Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC and RNG

3. IR Sensors

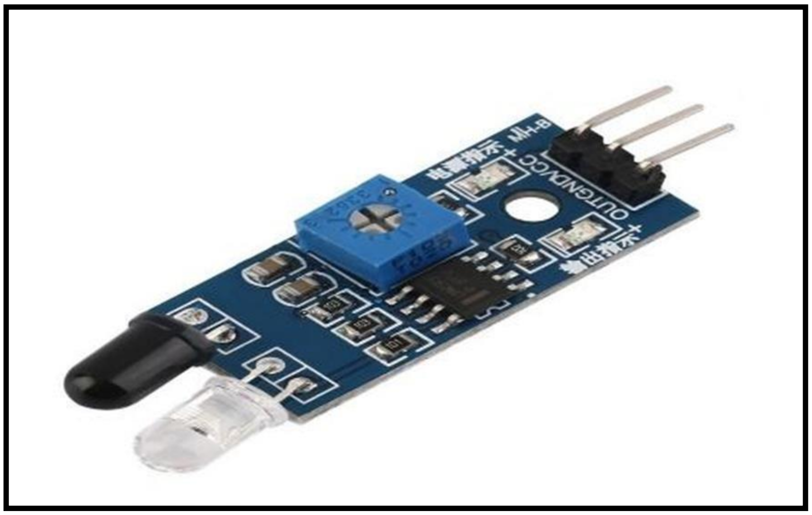


Fig 4.2.3 IR Sensors

Table 4.2.3: Hardware Specifications of IR Sensors

Board Size	3.2 x 1.4cm
Working voltage	3.3 to 5V DC
Operating voltage	3.3V: ~23 mA, to 5V: ~43 mA
Detection range	2cm – 30cm (Adjustable using potentiometer)
Active output level	The output is “0” (Low) when an obstacle is detected

4. MOSFET

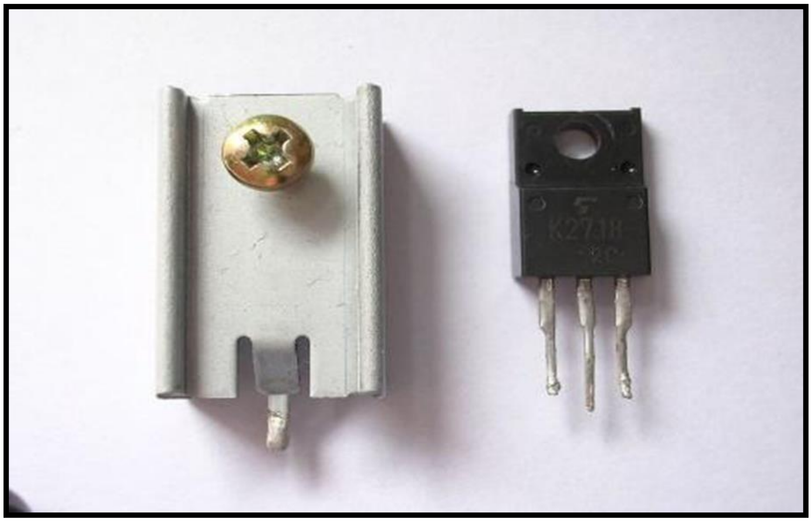


Fig 4.2.4 MOSFET

Table 4.2.4: Hardware Specifications of MOSFET

1. Small signal N-Channel MOSFET
2. Continuous Drain Current (ID) is 49A at 25°C
3. Pulsed Drain Current (ID-peak) is 160A
4. Minimum Gate threshold voltage (VGS-th) is 2V
5. Maximum Gate threshold voltage (VGS-th) is 4V
6. Gate-Source Voltage is (VGS) is ±20V (max)
7. Maximum Drain-Source Voltage (VDS) is 55V
8. Rise time and fall time are about 60ns and 45ns respectively.
9. It is commonly used with Arduino, due to its low threshold current.
10. Available in To-220 package

4.3. Design Consideration

The following design factors should be taken into account when creating a wireless power transfer system that can increase its range of uses and perhaps allow completely wireless systems for automobiles and other devices:

Universal Acceptance:

To guarantee broad adoption, the system design should take compatibility and standardization into mind across many nations and regions.

Establishing uniform standards and laws for wireless power transmission requires cooperation with global regulatory agencies and industry players.

Flexibility and Scalability:

Create a scalable system that can handle different power levels and uses, such as electric cars and tiny electronic gadgets.

Make sure that coil designs, frequencies, and power levels are flexible enough to accommodate various use cases and environmental conditions.

Infrastructure for Dynamic Charging:

Install wireless charging stations for stationary cars; later, add dynamic charging lanes for cars that are moving. Think about infrastructure rollout methods that give priority to places with limited access to traditional charging infrastructure, metropolitan centers, and high-traffic routes.

Compatibility and interoperability:

Create a system that can work with the current charging standards and platforms for electric vehicles, including CHAdeMO, CCS, and Tesla Supercharger.

To support cars lacking wireless charging capability, make sure plug-in charging alternatives are backward compatible.

Effectiveness and Security:

Reduce energy losses and increase power transfer efficiency by optimizing the wireless power transfer system. To guarantee safe functioning for users and neighboring electronic equipment, incorporate safety measures including temperature management, electromagnetic compatibility (EMC) shielding, and overcurrent prevention.

CHAPTER 5

Chapter No. 5

Software Implementation

5.1. Software Required

1. Arduino IDE:

The Arduino Integrated Development Environment (IDE) is a user-friendly software application designed for writing, compiling, and uploading code to Arduino microcontroller boards. It offers a simple yet powerful interface with features such as a code editor, library manager, board manager, serial monitor, and examples/tutorials. With cross-platform compatibility and streamlined workflows, the Arduino IDE enables users of all skill levels to quickly prototype and develop a wide range of electronic projects, from simple blinking LED experiments to complex robotics applications.

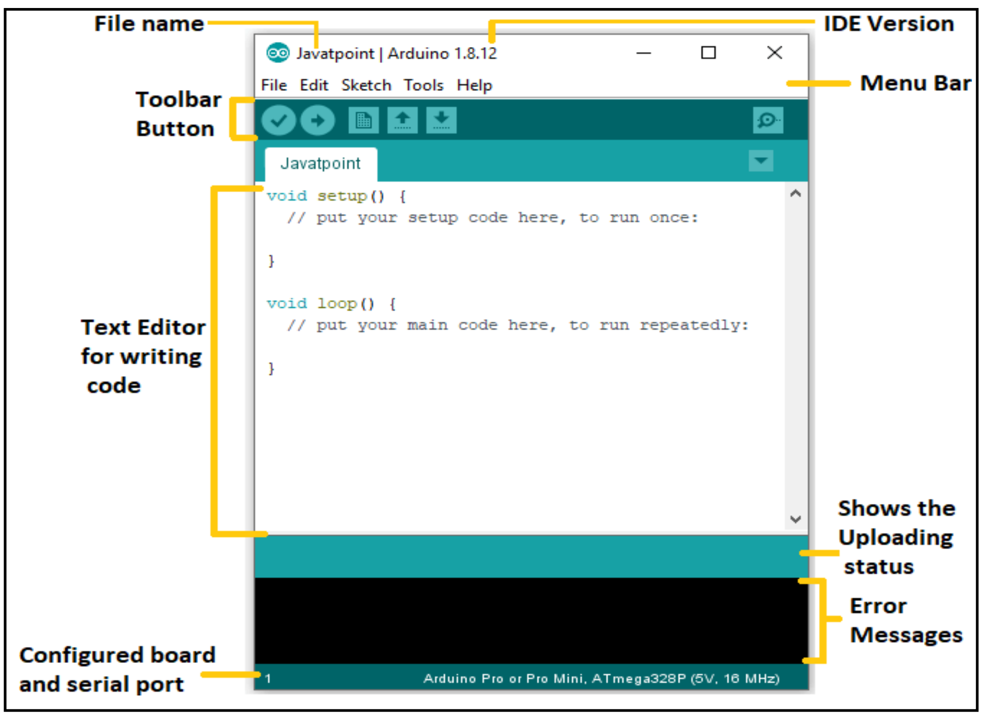


Fig 5.1.1 Arduino IDE Interface

2. Blynk app

Blynk is a versatile mobile application designed to simplify the process of creating IoT (Internet of Things) projects by enabling users to control and monitor connected devices remotely. With Blynk, users can easily build custom interfaces, known as "widgets," to interact with a wide range of hardware platforms, including Arduino, Raspberry Pi, ESP8266, and others, without the need for extensive coding knowledge. The app offers an intuitive drag-and-drop interface, allowing users to quickly design their interface by selecting from a variety of widgets such as buttons, sliders, gauges, and graphs. Blynk also provides a cloud-based infrastructure for seamless communication between the mobile app and the connected devices, enabling real-time data visualization, push notifications, and secure remote-control capabilities. Overall, Blynk empowers users to create innovative IoT solutions tailored to their specific needs, making it a valuable tool for hobbyists, educators, and professionals alike.

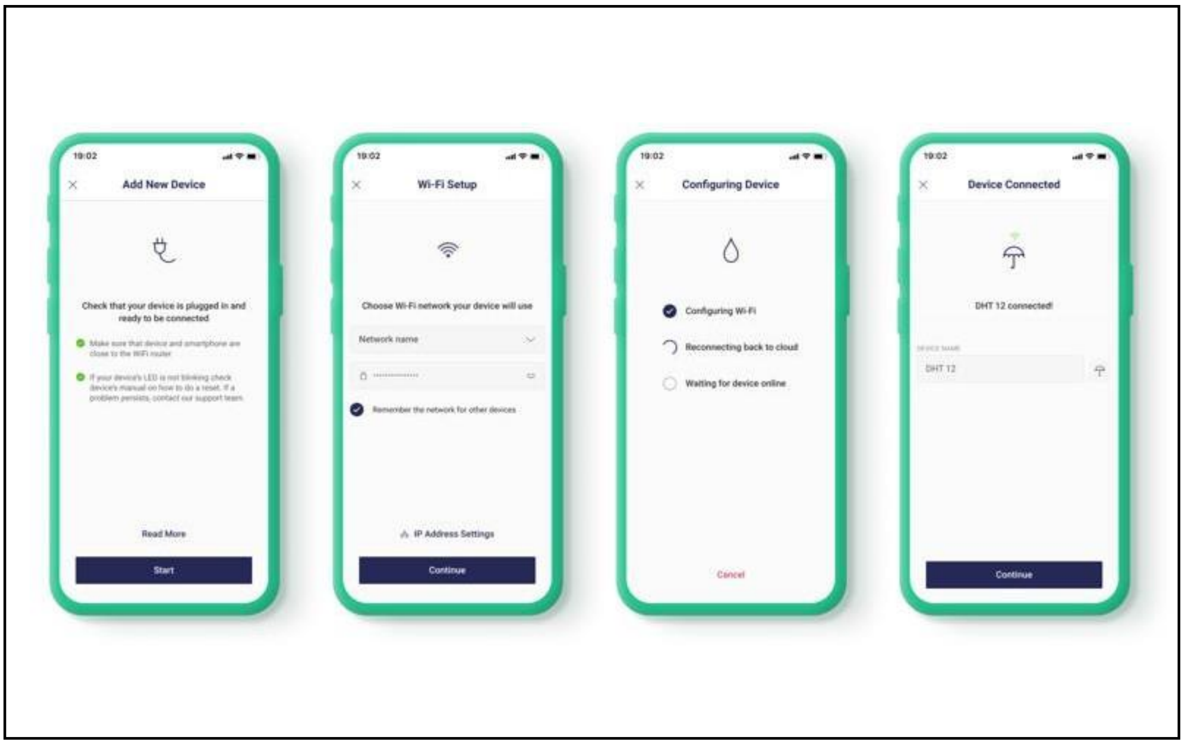


Fig 5.1.2 Blynk app Interface

5.2. Software specification

1. Arduino IDE:

Specifications:

Legacy IDE(1.8.X)- Arduino IDE(1.8.19).

2. Blynk App:

Specifications:

Blynk IOT App- Version:2.27.34

5.3. Implementation

Step 1: Set Up Blynk Account and Project:

Produce an account on the Blynk platform if you have not formerly.

Log in to your Blynk account and produce a new design.

Gain the authentication commemorative handed by Blynk for your design.

Step 2:Install Blynk Library in Arduino IDE:

Open Arduino IDE and navigate to Sketch > Include Library > Manage Libraries.

Search for "Blynk" and install the Blynk library by opting it and clicking "Install".

Step 3:Hardware Connection:

Ensure that your Arduino board is duly powered and functional.

Step 4:Write Arduino Sketch:

Open Arduino IDE and create a new sketch for your design.

Include the necessary libraries at the beginning of your sketch, such as Blynk and any additional libraries required for your project.

Step 5:Define Blynk Authentication Token:

Define the Blynk authentication token obtained earlier in your Arduino sketch using the char auth[] = "YourAuthToken"; statement.

Step 6:Set Up Virtual Pins:

Define virtual pins in your Arduino sketch to establish communication between the Blynk app and your hardware. Assign functions to these virtual pins to control specific actions, such as turning the charging spot on or off.

Step 7:Write Code for Interfacing with Blynk App:

Implement code to handle incoming commands from the Blynk app through virtual pins.

Define functions to respond to these commands and perform corresponding actions, such as activating or deactivating the charging spot.

Step 8:Test Communication with Blynk App:

Upload the Arduino sketch to your Arduino board.

Open the Blynk app on your smartphone and add the necessary widgets (e.g., buttons, switches) to control the charging spot.

Ensure that the hardware responds appropriately to commands sent from the Blynk app.

Step 9:Debug and Refinement:

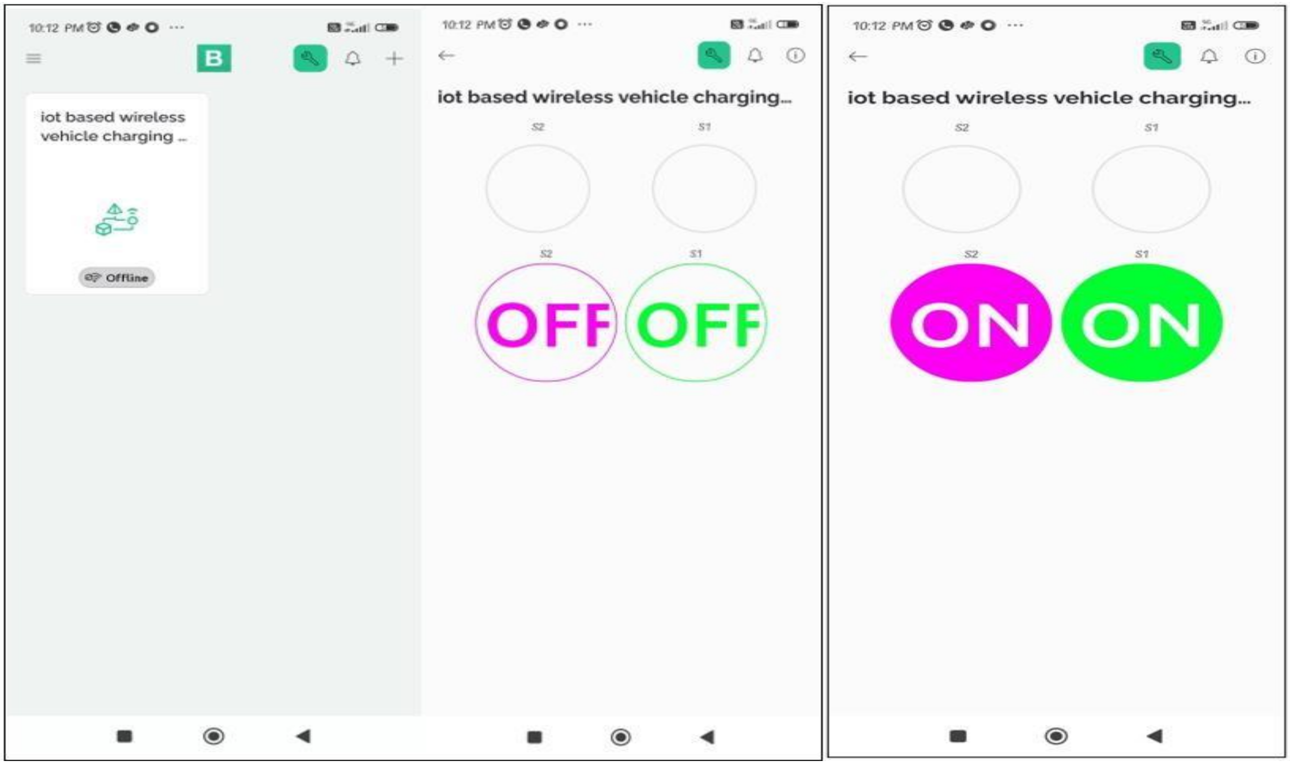
Test the functionality of your system under various conditions and scenarios.

Debug any issues that arise during testing and refine your code as needed to improve performance and reliability.

Step 10:Documentation and Deployment:

Document the implementation steps, including code snippets, hardware connections, and troubleshooting tips.

Prepare user documentation or instructions for deploying the system, including how to set up and use the Blynk app interface.



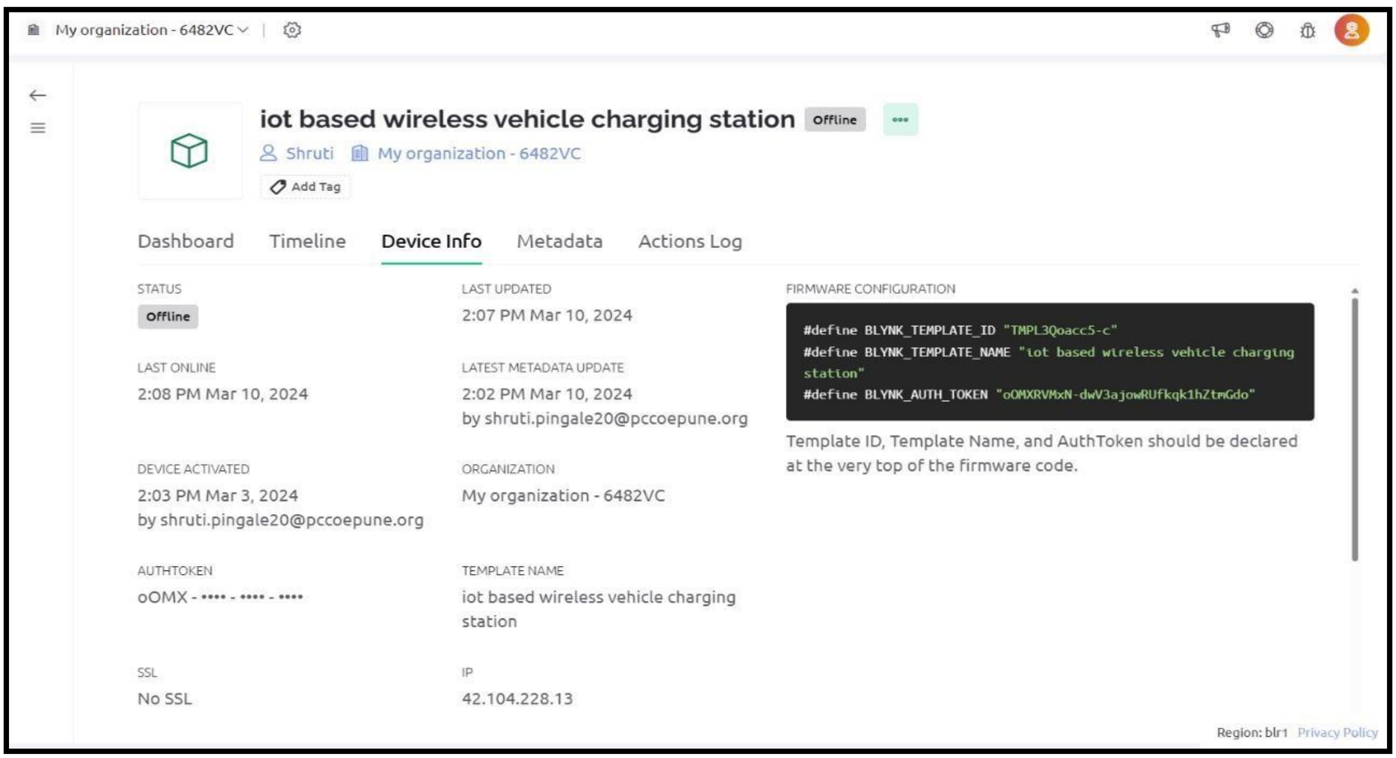


Fig 5.3.1 App Implementation Screenshots

CHAPTER 6

Chapter No. 6
Testing & Troubleshooting

6.1. Testing

Wireless Power Transmission Mechanism:

- Wireless power transfer (WPT) using magnetic resonance is the technology which could set humans free from the annoying wires.
- The advances make the WPT very attractive to the electric vehicle (EV) charging applications in both stationary and dynamic charging scenarios.
- It includes several stages to charge an EV wirelessly. First, the utility ac power is converted to a dc power source by an ac to dc converter with power factor correction.
- Then, the dc power is converted to a high-frequency ac to drive the transmitting coil through a compensation network.
- The high-frequency current in the transmitting coil generates an alternating magnetic field, which induces an ac voltage on the receiving coil. By resonating with the secondary compensation network, the transferred power and efficiency are significantly improved. At last, the ac power is rectified to charge the battery.

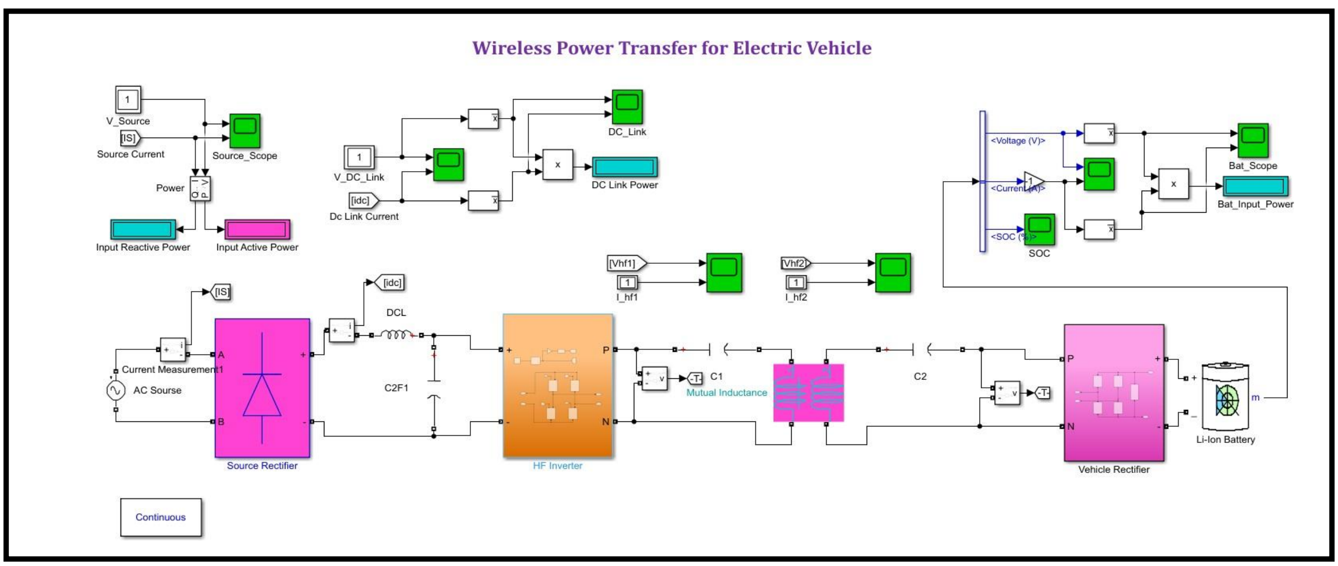


Fig:6.1.1 Simulink Model for Wireless Power Transfer

6.2. Testing strategies & Test Procedures

1. Road side winding voltage Vs Road side winding current:

The graph depicting the relationship between roadside winding voltage and road winding current serves as a valuable tool for analyzing, optimizing, designing, and monitoring wireless charging systems for electric vehicles, contributing to the advancement and adoption of sustainable transportation technologies. Here are some factors that explains how this works:

1. **Inductive electricity Transfer (IPT)** systems transfer electricity wirelessly between two coils: a primary coil situated on the road surface and a secondary coil positioned on the vehicle. These coils provide a magnetic coupling that allows power to be delivered from the primary (roadside) coil to the secondary (vehicle-mounted) coil without the need for physical contact.

2. **Roadside winding voltage**: is the voltage induced in the primary coil buried in the road surface. This voltage is usually produced by an alternating current (AC) power source. As the current runs through the main coil, it forms a fluctuating magnetic field surrounding the coil, which induces a voltage in the secondary coil.
3. **Road Winding Current:** The road winding current is the alternating current that passes through the primary coil installed in the road surface. This current is supplied by the power source and is utilized to generate the magnetic field required to transfer power to the vehicle.
4. **Power Transfer Mechanism:** When an EV with a secondary coil approaches a main coil buried in the road, the fluctuating magnetic field causes a voltage in the secondary coil. This voltage is rectified and converted to direct current (DC) to charge the EV's battery.
5. **Efficiency and Power Management:** The efficiency of power transmission in IPT systems is determined by parameters such as coil distance, coil shape, and coil alignment. Optimizing the road winding current and roadside winding voltage is critical for delivering high-efficiency power transmission while reducing losses and guaranteeing safe operation.
6. **Regulation and Safety**: Roadside winding voltage and current must be kept below acceptable levels to prevent coil overheating, assure compatibility with the vehicle's charging system, and meet regulatory criteria for electromagnetic radiation and safety.

7. **Dynamic Charging:** In some applications, such as dynamic wireless charging for electric vehicles in motion (e.g., buses or taxis), the road winding current and roadside winding voltage must be dynamically adjusted in order to track the vehicle's position and maintain efficient power transfer as it moves down the road.

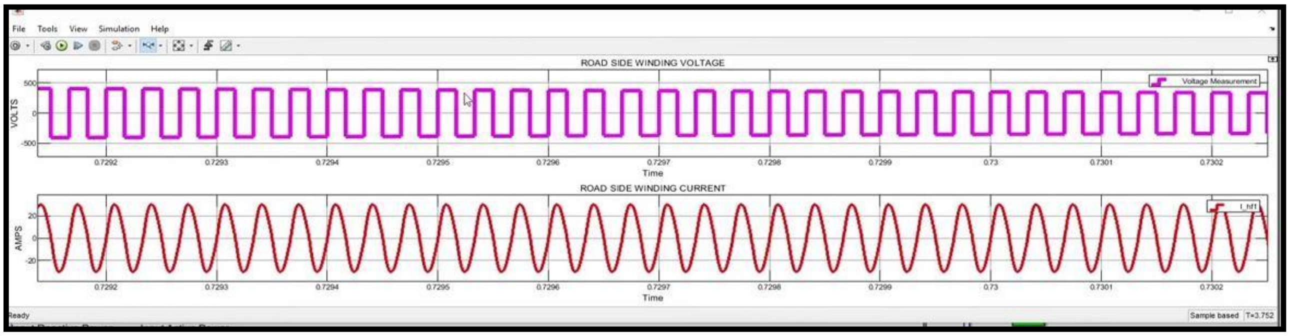


Fig:6.2.1 Road side winding voltage Vs Road side winding current.

2. Vehicle Side winding voltage Vs Vehicle Side winding current:

The relationship between vehicle-side winding voltage and vehicle-side winding current is essential for efficient power transfer in electric vehicles.

1. **Electric Vehicle Propulsion System:** In an EV, the electric propulsion system is normally made up of an electric motor that is coupled to the drivetrain. This motor transforms electrical energy from the vehicle's battery into mechanical energy, which drives the wheels.

2. **Motor Characteristics:** When an EV's electric motor is powered by an electric current, winding coils in the stator produce a revolving magnetic field. This magnetic field interacts with the rotor to generate torque, which propels the vehicle.

3. **Voltage and Current Requirements:** The voltage provided to the motor windings controls the strength of the magnetic field created, which has a direct impact on the motor's torque output. Meanwhile, the current passing through the windings affects the amount of electrical power supplied to the motor, and hence the mechanical power output.

4. **Efficiency and Range Considerations:** For EVs, increasing power transfer efficiency is critical for boosting range while reducing energy usage. Efficient power transmission reduces losses, allowing the battery's stored energy to be more efficiently used for propulsion.

5. **Regenerative Braking:** In addition to power supply during acceleration, electric vehicles use regenerative braking systems to collect energy during deceleration. During regenerative braking, the electric motor acts like a generator, turning kinetic energy into electrical energy. Understanding the voltage-current connection is critical for effective energy recovery during braking.

6. **Charging Considerations**: The same concepts apply to the charging procedure of an electric vehicle. When an electric vehicle (EV) is hooked into a charging station, power is delivered from the grid to the battery. Monitoring the voltage and current while charging assures safety and efficient charging operations.

7. **Battery Management:** To effectively manage the vehicle's battery system, voltage and current must be monitored while both charging and discharging. Maintaining proper voltage and current levels extends battery life and guarantees safe operation.

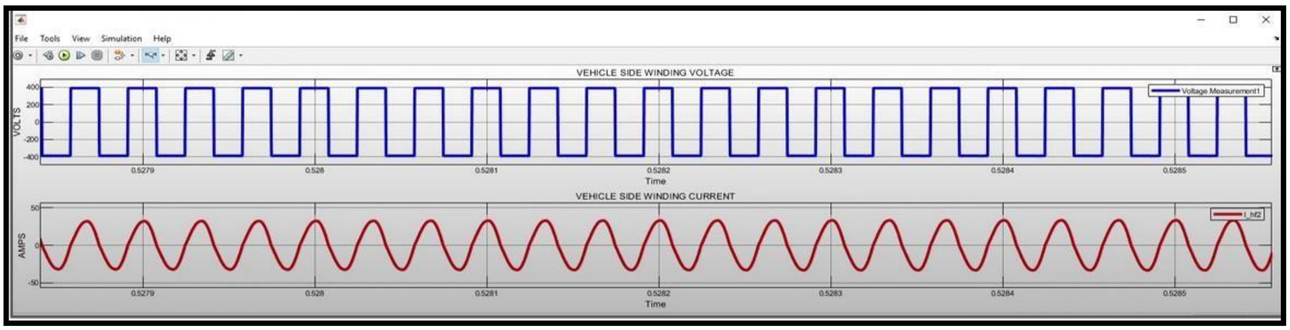


Fig:6.2.2 Vehicle Side winding voltage Vs Vehicle Side winding current

3. Source Voltage Vs Source Current:

A source voltage vs. source current graph provides valuable insights into the behavior of the power source (typically the battery or charging station) and its interaction with the vehicle's power electronics system.

1. **Source Voltage:** The source voltage indicates the electrical potential delivered by the power source, which can be the EV's battery pack or an external charging station. The voltage level determines the potential energy available for transmission to the vehicle's propulsion system.

2. **Source current** is the flow of electrical charge from a power source to the vehicle's power electronics system. It indicates the rate at which electrical energy is provided or extracted from the source.

3. **Charging Phase**: When the EV is linked to an external power source (such as a charging station), the source voltage remains generally constant, indicating the voltage level delivered by the charging infrastructure. Meanwhile, the source current fluctuates depending on the user-selected charging rate, the battery's level of charge, and any limitations imposed by the charging infrastructure or the vehicle's onboard charging system.

4. **Charging Curve**: During charging, the source voltage vs. source current graph often exhibits a relationship in which the source voltage remains relatively consistent (around the charging infrastructure's rated voltage) and the source current steadily drops as the battery charges. This curve may show a tapering effect, which indicates a reduction in charging current as the battery approaches its maximum state of charge.

5. **Discharging Phase**: When the vehicle's electric motor pulls power from the battery to move it, the source voltage reduces owing to the battery's internal resistance, causing voltage dips across the vehicle's power electronics system. The source current fluctuates depending on vehicle speed, acceleration, and terrain.

6. **Load Profile:** The contour of the source voltage vs. source current curve during the discharge phase is determined by the vehicle's power consumption. larger power needs (for example, during acceleration or uphill driving) result in larger source currents but potentially lower source voltages due to voltage sag.

7. **Efficiency Considerations**: Examining the source voltage vs. source current graph can assist determine the efficiency of the power transfer process. Efficiency may be determined by assessing how closely the actual source current matches the desired charging or discharging profile. Any variations might suggest issues with the charging infrastructure, power electronics, or battery system.

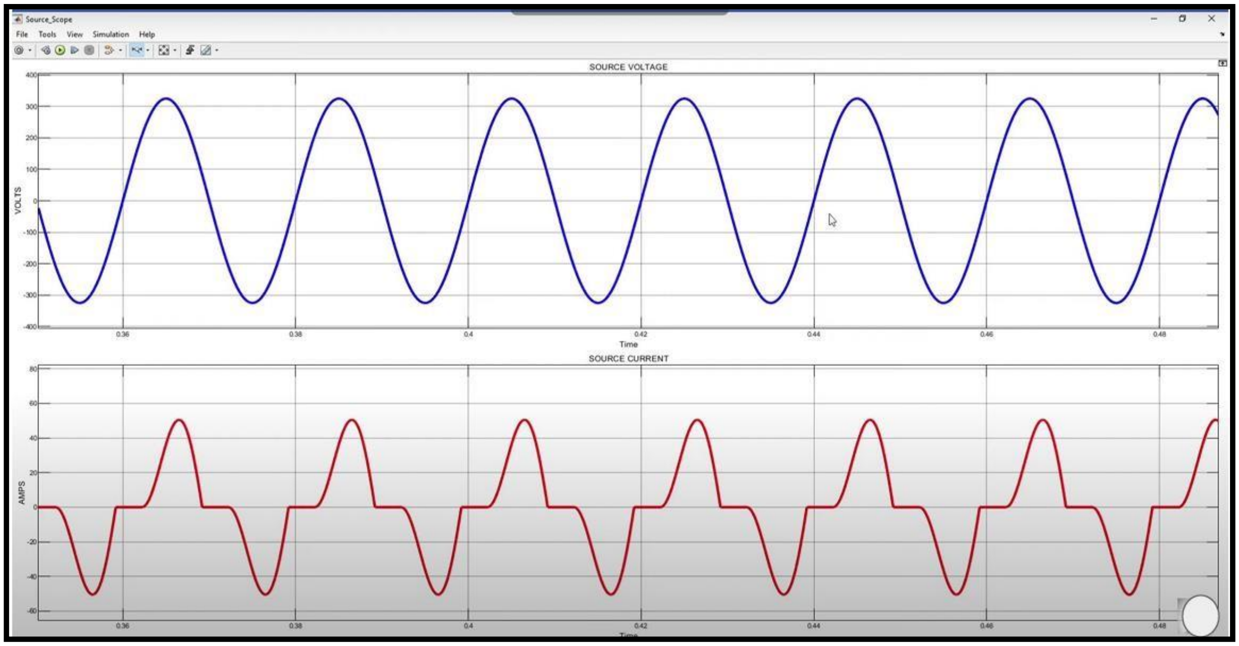


Fig:6.2.3 Source Voltage Vs Source Current

6.3. Results & Analysis

A dynamic electric car charging system's performance study entails assessing a number of factors, including cost-effectiveness, safety, power transfer capabilities, and efficiency. Let's dissect the salient features of the performance analysis to learn more about it:

Effectiveness:

For dynamic electric car charging systems to reduce energy losses during power transmission, efficiency is essential. By comparing the input power (Pin) and output power (Pout) at various RLC combinations, determine the system's efficiency.

Examine the efficiency under various working scenarios, including differences in load impedance, misalignments between the transmitter and receiver coils, and varied charging distances.

Take into account losses in the coupling, resonance tuning mechanisms, and power electronics.

Capability of Power Transfer:

Analyze how well the system works in different environments and at different distances for wireless power transmission.To ascertain the highest possible power transmission capability while preserving efficiency and safety, run models or tests.Examine how coil shape, frequency, and coupling coefficient affect the capacity to transmit power.Examine dynamic power control techniques to modify power transmission in an adaptable manner according to road conditions, battery level, and vehicle speed.

Security:

Dynamic electric car charging systems must prioritise safety in order to guard against risks including electric shock, overheating, and electromagnetic interference.To guarantee adherence to legal requirements and reduce interference with other electronic systems, analyse electromagnetic interference (EMI).

Economy of scale:

Examine the wireless charging system's cost-effectiveness by taking into account the costs of the hardware, installation, upkeep, and operation.Analyse the expenses in relation to traditional plug-in charging infrastructure while taking customer convenience, energy losses, and infrastructure rollout costs into account.Examine ways to save costs by using economies of scale, more efficient production processes, and component optimisation.

Control and Integration of Systems:

Examine how the power infrastructure and electric cars are integrated with the wireless charging technology.Create reliable control algorithms that maximize the effectiveness of power transmission, reduce the amount of time needed for charging, and guarantee compatibility with various car types.

For grid services and vehicle-to-grid (V2G) applications, take into account bidirectional power flow capabilities.Examine the charging system's scalability and interoperability to ensure that it can be widely used in metropolitan areas and beside highways.

CHAPTER 7

Chapter No. 7
Advantages & Applications

7.1. Advantages:

Corrosion Prevention: Enclosing electronics in wireless charging systems protects them from exposure to oxygen and water, minimizing the risk of corrosion. This design choice contributes to secure connections and reduces the likelihood of electrical malfunctions, such as short circuits during frequent connections and disconnections.

Reduced Wear and Tear: Wireless charging eliminates the need for constant plugging and unplugging, significantly reducing wear and tear on device sockets and attached cables. This feature enhances the durability of electronic gadgets and extends their overall lifespan.

Infection Risk Reduction: In embedded medical devices, wireless charging eliminates the risk of infections associated with cables penetrating the skin. The use of magnetic fields for electricity transfer ensures a safe and hygienic charging process.

Driving Range Expansion: High-power inductive charging facilitates the expansion of the driving range for electric vehicles. This automated charging method enhances practicality and visual appeal by eliminating visible charging cords.

Durability for Self-Driving Cars: Wireless charging addresses the need for continuous electric charging in self-driving cars. The automatic inductive charging capability theoretically allows these vehicles to operate indefinitely, overcoming the challenge of electric charging for autonomous vehicles.

Dynamic Charging for Moving Vehicles: Inductive charging at high power levels, known as dynamic charging, enables electric vehicles to charge while in motion. This advancement enhances the flexibility and convenience of electric vehicle charging, providing a significant contribution to sustainable transportation solutions.

7.2. Applications

Electric Vehicle Charging Infrastructure:

Integration of wireless charging systems into existing EV charging infrastructure, offering convenient and cable-free charging solutions for electric vehicles.

Transportation Industry:

Implementation of wireless charging technology in public transportation fleets, including buses and taxis, to streamline charging processes and reduce downtime.

Consumer Electronics:

Adoption of wireless charging systems in smartphones, tablets, and wearable devices, providing users with convenient and cable-free charging options.

Healthcare Sector:

Utilization of wireless charging technology in medical devices, such as implantable devices and wearable health monitors, ensuring safe and hygienic charging solutions.

Industrial Automation:

Integration of wireless charging systems into robotic systems and automated machinery in manufacturing facilities, minimizing downtime and optimizing productivity.

Smart Infrastructure Development:

Incorporation of wireless charging technology into smart city infrastructure, including streetlights and public benches, offering convenient charging options for residents and visitors.

Renewable Energy Integration:

Integration of wireless charging systems with renewable energy sources, such as solar panels and wind turbines, to facilitate sustainable and eco-friendly charging solutions.

Military Applications:

Deployment of wireless charging technology in military vehicles and equipment, enabling efficient and reliable charging solutions in remote or harsh environments.

Maritime Industry:

Implementation of wireless charging systems in electric boats and maritime vessels, providing convenient and cable-free charging options for marine applications.

CHAPTER 8

Chapter No. 8
Conclusion & Future scope

8.1. Conclusion

In conclusion, wireless charging eliminates the need for bulky wires and plug points, making it a straightforward and cutting-edge way to charge electric cars (EVs). demonstrating the effectiveness and usefulness of this technology, when the EV is parked above the wireless charger, electricity is created in the coil located at the bottom of the vehicle by mutual induction. Additionally, the expansion of wireless charging to allow charging while driving signifies a substantial development in EV charging capabilities, offering users increased convenience and flexibility. With implications for the future of transportation infrastructure, this evolution highlights the ongoing innovation in the field of wireless power transfer.

This report envisions future technologies like RFID tag payment and self-service entry and exit gates, highlighting the potential of wireless charging systems to change EV charging stations. The aforementioned enhancements are intended to optimize workflow, reduce traffic, and improve the overall user experience at charging stations. All things considered, the investigation of wireless charging technology in this work makes a significant addition to the area by providing insights into its effectiveness, use, and possible future advancements. As wireless charging develops further, it has the potential to completely disrupt not just the transportation sector but also a number of other industries, such as consumer electronics, healthcare, and industrial automation, thereby establishing itself as a game-changing technological advancement.

8.2. Future scope

Dynamic charging solutions that are high-performing, safe, and reasonably priced will be at the vanguard of the electric vehicle (EV) revolution, which has the potential to completely change road transportation in the future. Finding the best mix of capacitive and inductive.

Wireless Power Transfer (WPT) technologies is essential to this evolution and offers huge research opportunities in near-field coupler design and high-frequency power electronics. Additional research should be done in a few crucial areas: The long-term health effects of being exposed to weak electric and magnetic fields produced by dynamic charging devices require more research in order to ensure the safety of both users and onlookers.

Object Detection: To guarantee public safety and prevent mishaps, it is crucial to have strong systems for identifying live things and foreign items near WPT systems.

Optimal Charging Parameters: To maximize the advantages of dynamic charging infrastructure, performance and cost-effectiveness must be optimized. This requires methods to identify the most efficient charger power levels and spacing.

Combining Roadways with Integration: The development of methods for smoothly integrating WPT technology into traffic will be essential for its broad adoption and for making it possible for EVs to be conveniently charged while traveling.

Moreover, we can add solar energy via photovoltaic (PV) panels in this current project. Solar energy is one of the top-rank renewable energy resources which cannot be harmful to the natural environment. And also, we can do dynamic wireless charging which is more-advanced technology than the static wireless charging since the battery car has to be charged while moving on the road.

References:

1] Ronak Ramesh Sancheti, Chetan Shivaji Kurkute, Prasad Sanjay Karmalkar, Aryan Gupte, Dr. Preeti Patil,"Iot-Based Wireless EV Charging System For Electric Vehicle Using Inductive Power Coils." in IJCSPUB:Volume 13, Issue 2 May 2023 | ISSN: 2250-1770

2] P. Paul, P. Mohanty, S. S. Mahapatra, and D. K. Pradhan, "Design of Wireless Charging Station for Electric Vehicles using ESP32 with IoT-Based Monitoring System," in 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 57-62, doi: 10.1109/ICACCS52232.2021.9373304.

3] D. Mandal, S. Singh, S. Biswas, S. Roy, S. S. Saha, and S. K. Ray, "Design and Implementation of a Multi-Device Wireless Charging Station Using ESP32," in 2021 6th International Conference on Control, Automation and Robotics (ICCAR), Nagoya, Japan, 2021, pp. 385-390, doi: 10.1109/ICCAR50762.2021.9428705

4] A. Sharma, R. A. Mehta, and J. K. Solanki, "Design and Implementation of Wireless Power Transfer System for Electric Vehicle Using Inductive Power Transfer Technique," in 2020 3rd International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2020, pp. 153-157, doi: 10.1109/ICIRCA49224.2020.9126167

5] C. Li, Z. Chen, C. Song, and J. Liu, "Design and Implementation of Wireless Charging System for Wearable Devices Using Inductive Power Transfer Technology," in 2020 IEEE 4th Information Technology, Networking, Electronic and Automation Control Conference (ITNEC), Chengdu, China, 2020, pp. 763-767, doi: 10.1109/ITNEC48647.2020.9149563

6] Pranav Nakil, Ronak Sancheti, Rahul Sangamnere, Bhushan Hire, and Prof. Vijay J. Chaudhari. "WIRELESS CHARGING LANE & STATION FOR E-VEHICLE" International Journal Of Advance Research And Innovative Ideas In Education Volume 6 Issue 2 2020 Page 107-110

7] B. Bao, W. Sun, J. Zhang and X. Yuan, "Analysis of the Distance between adjacent Transmitting Coils in Segmented Dynamic Wireless Charging," 2021 IEEE 4th International Electrical and Energy Conference (CIEEC), 2021, pp. 1-5, doi: 10.1109/CIEEC50170.2021.9510674.

8] S. Obayashi, Y. Kanekiyo and T. Shijo, "UAV/Drone Fast Wireless Charging FRP Frustum Port for 85-kHz 50-V 10-A Inductive Power Transfer," 2020 IEEE Wireless Power Transfer Conference (WPTC), 2020, pp. 219-222, doi: 10.1109/WPTC48563.2020.9295562

9] S. Obayashi, Y. Kanekiyo and T. Shijo, "UAV/Drone Fast Wireless Charging FRP Frustum Port for 85-kHz 50-V 10-A Inductive Power Transfer," 2020 IEEE Wireless Power Transfer Conference (WPTC), 2020, pp. 219-222, doi: 10.1109/WPTC48563.2020.9295562

10] M. Su, T. Ling, Q. Zhu and P. Wang, "One-Sided Magnetic Field Halbach Pad for EV Wireless Charging," 2019 IEEE PELS Workshop on Emerging Technologies: Wireless Power Transfer (WoW), 2019, pp. 226-228, doi: 10.1109/WoW45936.2019.9030653

11] Cheng, K.W.E., Divakar, B.P., Wu, H., Ding, K. and Ho, H.F. (2011) Battery-Management System (BMS) and SOC Development for Electrical Vehicles. IEEE Transactions on Vehicular Technology, 60, 76-88.

12] Mathew, S.A., Prakash, R. and John, P.C. (2012) A Smart Wireless Battery Monitoring System for Electric Vehicles. 2012 12th International Conference on Intelligent Systems Design and Applications (ISDA), 189-193.

IoT-Based Wireless EV Charging System for Electric Vehicle

ORIGINALITY REPORT

9%

SIMILARITY INDEX

PRIMARY SOURCES

1	ijcspub.org Internet	123 words	— 2%
2	www.researchgate.net Internet	18 words	— 1%
3	sersc.org Internet	16 words	— 1%
4	www.kscst.iisc.ernet.in Internet	102 words	— 2%
5	wwww.easychair.org Internet	58 words	— 1%
6	ijisrt.com Internet	27 words	— 1%
7	www.ijcspub.org Internet	27 words	< 1%
8	www.ijert.org Internet	11 words	< 1%
9	sinergiejournal.eu Internet	10 words	< 1%

Appendix A: Data sheets

1. Overview

ESP32-WROOM-32 is a powerful, generic Wi-Fi+BT+BLE MCU module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding.

At the core of this module is the ESP32-D0WDQ6 chip*. The chip embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 MHz. The user may also power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds. ESP32 integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, SD card interface, Ethernet, high-speed SPI, UART, I2S and I2C.

Note:
* For details on the part number of the ESP32 series, please refer to the document *ESP32 Datasheet*.

The integration of Bluetooth, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is future proof: using Wi-Fi allows a large physical range and direct connection to the internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection. The sleep current of the ESP32 chip is less than 5 μA, making it suitable for battery powered and wearable electronics applications. ESP32 supports a data rate of up to 150 Mbps, and 20.5 dBm output power at the antenna to ensure the widest physical range. As such the chip does offer industry-leading specifications and the best performance for electronic integration, range, power consumption, and connectivity.

The operating system chosen for ESP32 is freeRTOS with LwIP; TLS 1.2 with hardware acceleration is built in as well. Secure (encrypted) over the air (OTA) upgrade is also supported, so that developers can continually upgrade their products even after their release.

Table 1 provides the specifications of ESP32-WROOM-32.

Table 1: ESP32-WROOM-32 Specifications

Categories	Items	Specifications
Certification	RF certification	FCC/CE/IC/TELEC/KCC/SRRC/NCC
	Wi-Fi certification	Wi-Fi Alliance
	Bluetooth certification	BQB
	Green certification	RoHS/REACH
Wi-Fi	Protocols	802.11 b/g/n (802.11n up to 150 Mbps)
		A-MPDU and A-MSDU aggregation and 0.4 μs guard interval support
	Frequency range	2.4 GHz ~ 2.5 GHz
Bluetooth	Protocols	Bluetooth v4.2 BR/EDR and BLE specification
	Radio	NZIF receiver with –97 dBm sensitivity
		Class-1, class-2 and class-3 transmitter
		AFH
	Audio	CVSD and SBC

Categories	Items	Specifications
Hardware	Module interface	SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM, I2S, IR
		GPIO, capacitive touch sensor, ADC, DAC
	On-chip sensor	Hall sensor
	On-board clock	40 MHz crystal
	Operating voltage/Power supply	2.7 ~ 3.6V
	Operating current	Average: 80 mA
	Minimum current delivered by power supply	500 mA
	Recommended operating temperature range	–40°C ~ +85°C
	Package size	(18±0.2) mm x (25.5±0.2) mm x (3.1±0.15) mm
Software	Wi-Fi mode	Station/SoftAP/SoftAP+Station/P2P
	Wi-Fi Security	WPA/WPA2/WPA2-Enterprise/WPS
	Encryption	AES/RSA/ECC/SHA
	Firmware upgrade	UART Download / OTA (download and write firmware via network or host)
	Software development	Supports Cloud Server Development / SDK for custom firmware development
	Network protocols	IPv4, IPv6, SSL, TCP/UDP/HTTP/FTP/MQTT
	User configuration	AT instruction set, cloud server, Android/iOS app

Metallized Polyester Film Capacitors
MPMEF Series - Radial leaded

multicomp PRO

Features

- Metallized polyester film, non-inductive wound construction.
- Wide capacitance range, small size, and light weight.
- Self-healing
- Flame retardation epoxy resin coating

Applications

- Suitable for blocking, by-pass and coupling of DC and signals to VHF range.
- Widely used in filter and low pulse circuits.

Specifications

Reference Standard	: GB/T7332 (IEC 60384-2)
Climatic Category	: 40/105/21
Rated Temperature	: +85°C
Operating Temperature Range	: -40°C to +105°C (+85°C to + 105°C: decreasing factor 1.25% per °C for U_R)
Rated Voltage	: 250V, 400V, 630V
Capacitance Range	: 0.01µF to 4.7µF
Capacitance Tolerance	: ±5% (J)
Voltage Proof	: 1.6U_R (5s)
Dissipation Factor	: ≤1% (1kHz, 20°C)
Insulation Resistance	: U_R ≤ 100V ≥ 3,750MΩ Cn ≤ 0.33µF (20°C, 100V, 1min) U_R ≤ 100V ≥ 1,250s Cn > 0.33µF (20°C, 100V, 1min) U_R > 100V ≥ 30,000MΩ CN ≤ 0.33µF (20°C, 100V, 1min) U_R > 100V ≥ 5000s Cn > 0.33µF (20°C, 100V, 1min)

Max. Pulse Rise Time:

U_R (V)	dV/dt (V/µs) for pattern III				
	P=7.5	P=10	P=15	P=22.5	P=27.5
250	30	20	12	8	5
400	40	30	20	10	7
630	-	40	25	12	10

Note: If the working voltage(U) is lower than the rated voltage (U_R), the capacitor can be worked at a higher dV/dt. In this case, the maximum allowed dV/dt is obtained by multiplying the right value with U_R/U.

Dimensions : Millimetres

General Purpose Plastic Rectifier

DO-41 (DO-204AL)

FEATURES

- Low forward voltage drop
- Low leakage current
- High forward surge capability
- Solder dip 275 °C max. 10 s, per JESD 22-B106
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

PRIMARY CHARACTERISTICS	
$I_{F(AV)}$	1.0 A
V_{RRM}	50 V, 100 V, 200 V, 400 V, 600 V, 800 V, 1000 V
I_{FSM} (8.3 ms sine-wave)	30 A
I_{FSM} (square wave t_p = 1 ms)	45 A
V_F	1.1 V
I_R	5.0 μA
T_J max.	150 °C
Package	DO-41 (DO-204AL)
Circuit configuration	Single

TYPICAL APPLICATIONS

For use in general purpose rectification of power supplies, inverters, converters, and freewheeling diodes application.

MECHANICAL DATA

Case: DO-41 (DO-204AL), molded epoxy body
Molding compound meets UL 94 V-0 flammability rating
Base P/N-E3 - RoHS-compliant, commercial grade

Terminals: matte tin plated leads, solderable per J-STD-002 and JESD 22-B102
E3 suffix meets JESD 201 class 1A whisker test

Polarity: color band denotes cathode end

MAXIMUM RATINGS (T_A = 25 °C unless otherwise noted)

PARAMETER		SYMBOL	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	UNIT
Maximum repetitive peak reverse voltage		V_{RRM}	50	100	200	400	600	800	1000	V
Maximum RMS voltage		V_{RMS}	35	70	140	280	420	560	700	V
Maximum DC blocking voltage		V_{DC}	50	100	200	400	600	800	1000	V
Maximum average forward rectified current 0.375" (9.5 mm) lead length at T_A = 75 °C		$I_{F(AV)}$	1.0							A
Peak forward surge current 8.3 ms single half sine-wave superimposed on rated load		I_{FSM}	30							A
Non-repetitive peak forward surge current square waveform T_A = 25 °C (fig. 3)	t_p = 1 ms	I_{FSM}	45							A
	t_p = 2 ms		35							
	t_p = 5 ms		30							
Maximum full load reverse current, full cycle average 0.375" (9.5 mm) lead length T_L = 75 °C		$I_{R(AV)}$	30							μA
Rating for fusing (t < 8.3 ms)		I^2t (1)	3.7							A^2s
Operating junction and storage temperature range		T_J, T_{STG}	-50 to +150							°C

Note

(1) For device using on bridge rectifier application

ELECTRICAL CHARACTERISTICS (T_A = 25 °C unless otherwise noted)											
PARAMETER	TEST CONDITIONS		SYMBOL	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	UNIT
Maximum instantaneous forward voltage	1.0 A		V_F	1.1							V
Maximum DC reverse current at rated DC blocking voltage		T_A = 25 °C	I_R	5.0							μA
		T_A = 125 °C		50							
Typical junction capacitance	4.0 V, 1 MHz		C_J	15							pF

THERMAL CHARACTERISTICS (T_A = 25 °C unless otherwise noted)									
PARAMETER	SYMBOL	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	UNIT
Typical thermal resistance	$R_{\theta JA}$ (1)	50							°C/W
	$R_{\theta JL}$ (1)	25							

Note

(1) Thermal resistance from junction to ambient at 0.375" (9.5 mm) lead length, PCB mounted

ORDERING INFORMATION (Example)				
PREFERRED P/N	UNIT WEIGHT (g)	PREFERRED PACKAGE CODE	BASE QUANTITY	DELIVERY MODE
1N4004-E3/54	0.33	54	5500	13" diameter paper tape and reel
1N4004-E3/73	0.33	73	3000	Ammo pack packaging

RATINGS AND CHARACTERISTICS CURVES (T_A = 25 °C unless otherwise noted)

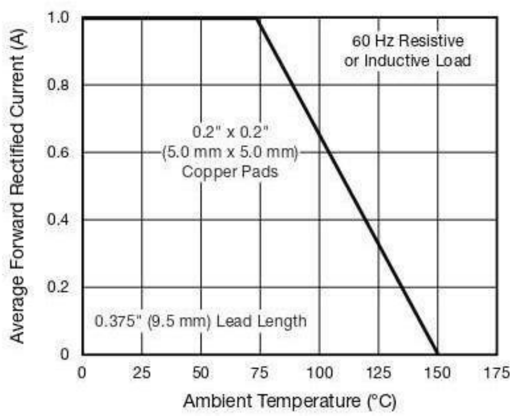


Fig. 1 - Forward Current Derating Curve

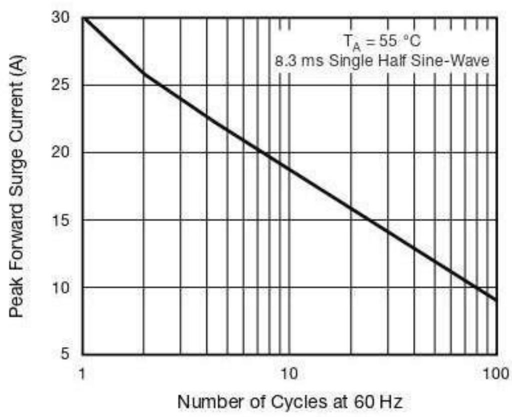


Fig. 2 - Maximum Non-repetitive Peak Forward Surge Current

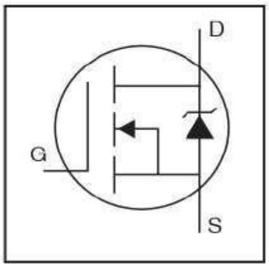
PD - 94787B

International
IOR Rectifier

IRFZ44NPbF

HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



V_{DSS} = 55V

$R_{DS(on)}$ = 17.5mΩ

I_D = 49A

Description

Advanced HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.

TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	49	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	35	
I_{DM}	Pulsed Drain Current ①	160	
P_D @ T_C = 25°C	Power Dissipation	94	W
	Linear Derating Factor	0.63	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
I_{AR}	Avalanche Current①	25	A
E_{AR}	Repetitive Avalanche Energy①	9.4	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	1.5	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient	——	62	

09/21/10

1. Features

1. 5x8 dots with cursor
2. 16characters *2lines display
3. 4-bit or 8-bit MPU interfaces
4. Built-in controller (ST7066 or equivalent)
5. Display Mode & Backlight Variations
6. ROHS Compliant

LCD type	☐TN			
	☐FSTN	☑FSTN Negative		
	☐STN Yellow Green	☐STN Gray	☐STN Blue Negative	
View direction	☑6 O'clock	☐12 O'clock		
Rear Polarizer	☐Reflective	☐Transflective	☑Transmissive	
Backlight Type	☑LED	☐EL	☐Internal Power	☑3.3V Input
		☐CCFL	☑External Power	☐5.0V Input
Backlight Color	☑White	☐ Blue	☐ Amber	☐Yellow-Green
Temperature Range	☑Normal	☐Wide	☐Super Wide	
DC to DC circuit	☐Build-in	☑Not Build-in		
Touch screen	☐With	☑Without		
Font type	☑English-Japanese	☐English-Europen	☐English-Russian	☐other

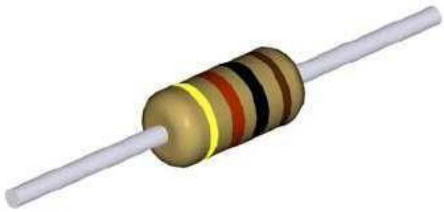
2. MECHANICAL SPECIFICATIONS

Module size	80.0mm(L)*36.0mm(W)* Max13.5(H)mm
Viewing area	64.5mm(L)*16.4mm(W)
Character size	3.00mm(L)*5.23mm(W)
Character pitch	3.51mm(L)*5.75mm(W)
Weight	Approx.

Data sheet
Carbon Film Leaded Resistor - RS Series

■Features

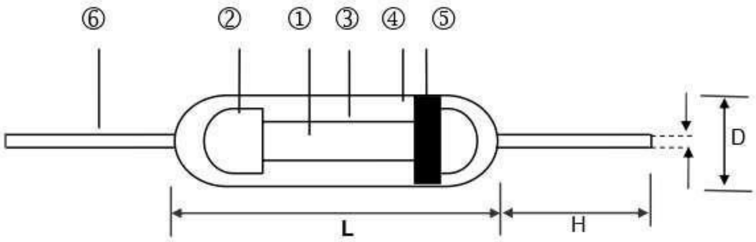
—The most economic industrial investment
—Standard tolerance: +/-5%
—Excellent long term stability
—Termination: Standard solder-plated copper lead



■Applications

- Automotive
- Telecommunication
- Medical Equipment

■Construction



①	Ceramic Rod	④	Non-flame Paint With Sol Vent-proof
②	Tinned Iron Caps	⑤	Colour Code
③	Carbon Film	⑥	Lead Wire

■Dimensions

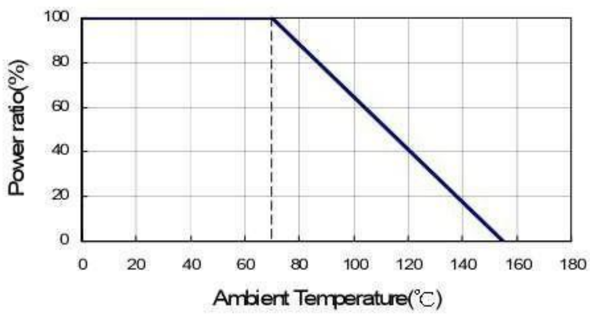
Unit: mm

Type	L	D	H	d	Weight (g) (1000pcs)
Carbon 0.125W	3.3+0.4/-0.2	1.8±0.3	29.3±2.0	0.452.3±0.03	92
Carbon 0.25W	6.3±0.5	2.3±0.3	28±2.0	0.55±0.03	155
Carbon 0.5W (H)	6.3±0.5	2.3±0.3	28±2.0	0.55±0.03	155
Carbon 1W (H)	9.0±0.5	3.2±0.5	26±2.0	0.65±0.03	352
Carbon 2W (H)	11.5±1.0	4.5±0.5	35±2.0	0.78±0.03	775

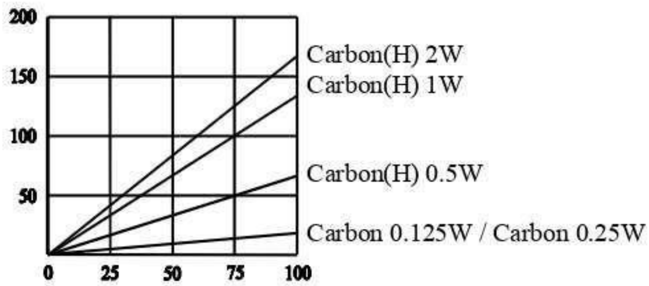
Pb RoHS Compliant

RS

■Derating Curve



■Hop-Spot Temperature



■Part Numbering

RS-	Carbon-	1R-	5%-	0.125W
Series	Type	Resistance	Tolerance	Power rating @ 70°C
	Carbon Carbon(H)	0.5R: 0.5 Ω 1R: 1Ω 10R: 10Ω 10K: 10KΩ 100K: 100KΩ	±5%	0.125W 0.25W 0.5W 1W 2W

■Electrical Specifications

Item / Type	Power Rating at 70°C	Operating Temp. Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range
						±5%
Carbon	0.125W	-55 ~ +155°C	150V	300V	300V	0.1Ω - 22MΩ
Carbon	0.25W		250V	500V	500V	1Ω - 10MΩ
Carbon(H)	0.5W		300V	500V	500V	0.1Ω - 22MΩ
Carbon(H)	1W		400V	800V	800V	1Ω - 10MΩ
Carbon(H)	2W		500V	1000V	1000V	0.1Ω - 10MΩ

1. Descriptions

The Multipurpose Infrared Sensor is an add-on for your line follower robot and obstacle avoiding robot that gives your robot the ability to detect lines or nearby objects. The sensor works by detecting reflected light coming from its own infrared LED. By measuring the amount of reflected infrared light, it can detect light or dark (lines) or even objects directly in front of it. An onboard RED LED is used to indicate the presence of an object or detect line. Sensing range is adjustable with inbuilt variable resistor.

The sensor has a 3-pin header which connects to the microcontroller board or Arduino board via female to female or female to male jumper wires. A mounting hole for easily connect one or more sensor to the front or back of your robot chassis.

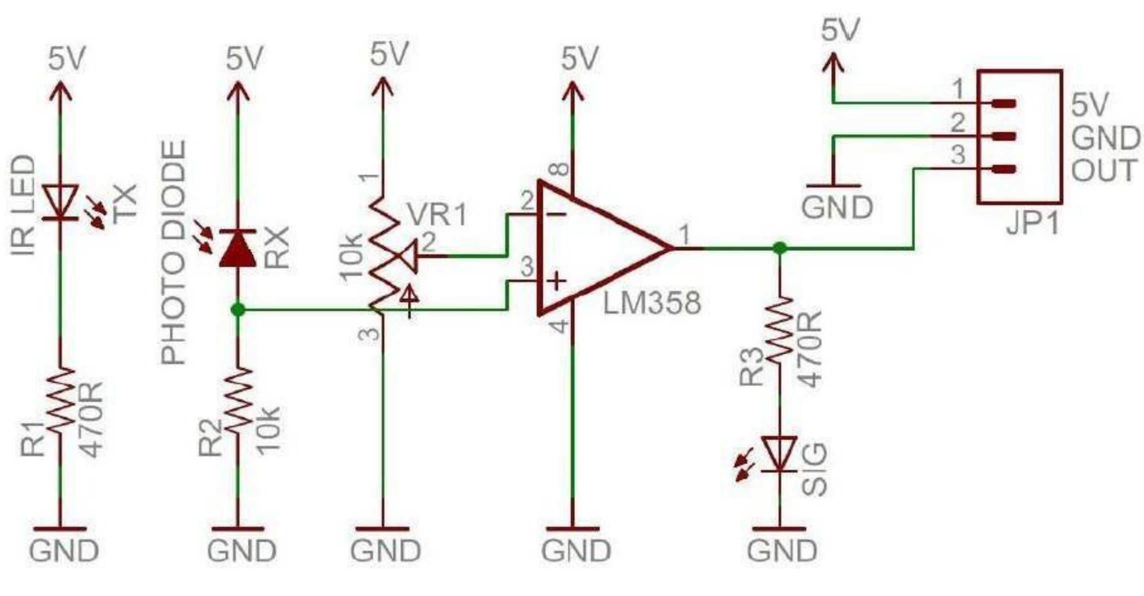
2. Features

- 5VDC operating voltage.
- I/O pins are 5V and 3.3V compliant.
- Range: Up to 20cm.
- Adjustable Sensing range.
- Built-in Ambient Light Sensor.
- 20mA supply current.
- Mounting hole.

3. Specifications

- Size: 50 x 20 x 10 mm (L x B x H)
- Hole size: ϕ2.5mm

4. Schematics



MEAN WELL

350W Single Output Switching Power Supply

LRS-350 series

User's Manual

R33100 RoHS
IS 13252(Part 1):2010/ IEC 60950-1:2005 R-41179035

AS/NZS62368-1 TP TC004 IEC62368-1 UL62368-1 (Note.9) (for LRS-350-12/24 only)

ECO Automate Industrial Security Network Telecom

Features

- AC input range selectable by switch
- Withstand 300VAC surge input for 5 second
- Protections: Short circuit / Overload / Over voltage / Over temperature
- Forced air cooling by built-in DC fan
- Built-in cooling Fan ON-OFF control
- 1U low profile
- Withstand 5G vibration test
- LED indicator for power on
- No load power consumption<0.75W
- 100% full load burn-in test
- High operating temperature up to 70℃
- Operating altitude up to 5000 meters (Note.8)
- High efficiency, long life and high reliability
- 3 years warranty

Applications

- Industrial automation machinery
- Industrial control system
- Mechanical and electrical equipment
- Electronic instruments, equipments or apparatus

GTIN CODE

MW Search: https://www.meanwell.com/serviceGTIN.aspx

Description

LRS-350 series is a 350W single-output enclosed type power supply with 30mm of low profile design. Adopting the input of 115VAC or 230VAC (select by switch), the entire series provides an output voltage line of 3.3V, 4.2V, 5V, 12V, 15V, 24V, 36V and 48V.
In addition to the high efficiency up to 89%, with the built-in long life fan LRS-350 can work under -25~ +70℃ with full load. Delivering an extremely low no load power consumption (less than 0.75W), it allows the end system to easily meet the worldwide energy requirement. LRS-350 has the complete protection functions and 5G anti-vibration capability; it is complied with the international safety regulations such as IEC/UL 62368-1. LRS-350 series serves as a high price-to-performance power supply solution for various industrial applications.

Model Encoding

LRS - 350 - 3.3

- 3.3 — Output voltage
- 350 — Output power
- LRS — Series name

MEAN WELL

350W Single Output Switching Power Supply **LRS-350 series**

SPECIFICATION

MODEL		LRS-350-3.3	LRS-350-4.2	LRS-350-5	LRS-350-12	LRS-350-15	LRS-350-24	LRS-350-36	LRS-350-48
OUTPUT	DC VOLTAGE	3.3V	4.2V	5V	12V	15V	24V	36V	48V
	RATED CURRENT	60A	60A	60A	29A	23.2A	14.6A	9.7A	7.3A
	CURRENT RANGE	0 ~ 60A	0 ~ 60A	0 ~ 60A	0 ~ 29A	0 ~ 23.2A	0 ~ 14.6A	0 ~ 9.7A	0 ~ 7.3A
	RATED POWER	198W	252W	300W	348W	348W	350.4W	349.2W	350.4W
	RIPPLE & NOISE (max.) Note.2	150mVp-p	150mVp-p	150mVp-p	150mVp-p	150mVp-p	150mVp-p	200mVp-p	200mVp-p
	VOLTAGE ADJ. RANGE	2.97 ~ 3.6V	3.6 ~ 4.4V	4.5 ~ 5.5V	10.2 ~ 13.8V	13.5 ~ 18V	21.6 ~ 28.8V	32.4 ~ 39.6V	43.2 ~ 52.8V
	VOLTAGE TOLERANCE Note.3	±4.0%	±4.0%	±3.0%	±1.5%	±1.0%	±1.0%	±1.0%	±1.0%
	LINE REGULATION Note.4	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
	LOAD REGULATION Note.5	±2.5%	±2.5%	±2.0%	±1.0%	±0.5%	±0.5%	±0.5%	±0.5%
	SETUP, RISE TIME	1300ms, 50ms/230VAC 1300ms,50ms/115VAC at full load							
	HOLD UP TIME (Typ.)	16ms/230VAC 12ms/115VAC at full load							
INPUT	VOLTAGE RANGE	90 ~ 132VAC / 180 ~ 264VAC by switch 240 ~ 370VDC (switch on 230VAC)							
	FREQUENCY RANGE	47 ~ 63Hz							
	EFFICIENCY (Typ.)	79.5%	81.5%	83.5%	85%	86%	88%	88.5%	89%
	AC CURRENT (Typ.)	6.8A/115VAC 3.4A/230VAC							
	INRUSH CURRENT (Typ.)	60A/115VAC 60A/230VAC							
	LEAKAGE CURRENT	<2mA / 240VAC							
PROTECTION	OVER LOAD	110 ~ 140% rated output power							
		3.3~36V Hiccup mode, recovers automatically after fault condition is removed. 48V Shut down and latch off o/p voltage, re-power on to recover.							
	OVER VOLTAGE	3.8 ~ 4.45V	4.6 ~ 5.4V	5.75 ~ 6.75V	13.8 ~ 16.2V	18 ~ 21V	28.8 ~ 33.6V	41.4 ~ 46.8V	55.2 ~ 64.8V
		3.3~36V Hiccup mode, recovers automatically after fault condition is removed. 48V Shut down and latch off o/p voltage, re-power on to recover.							
	OVER TEMPERATURE	3.3~36V Hiccup mode, recovers automatically after fault condition is removed. 48V Shut down and latch off o/p voltage, re-power on to recover.							
FUNCTION	FAN ON/OFF CONTROL (Typ.)	RTH3≧50℃ FAN ON, ≦40℃ FAN OFF							
ENVIRONMENT	WORKING TEMP.	-25 ~ +70℃ (Refer to "Derating Curve")							
	WORKING HUMIDITY	20 ~ 90% RH non-condensing							
	STORAGE TEMP., HUMIDITY	-40 ~ +85℃, 10 ~ 95% RH							
	TEMP. COEFFICIENT	±0.03%/℃ (0 ~ 50℃)							
	VIBRATION	10 ~ 500Hz, 5G 10min./1cycle, 60min. each along X, Y, Z axes							
SAFETY	SAFETY STANDARDS	IEC/UL 62368-1, BSMI CNS14336-1,EAC TP TC 004,KC K60950-1(for LRS-350-12/24 only), BIS IS13252(Part1): 2010/IEC60950-1: 2005, AS/NZS62368.1 approved; Design refer to BS EN/EN62368-1							
	WITHSTAND VOLTAGE	I/P-O/P:3KVAC I/P-FG:2KVAC O/P-FG:0.5KVAC							
	ISOLATION RESISTANCE	I/P-O/P, I/P-FG, O/P-FG:100M Ohms/500VDC / 25℃/ 70% RH							
	EMC EMISSION	Compliance to BSMI CNS13438, EAC TP TC 020,KC KN32,KN35(for LRS-350-12/24 only)							
	EMC IMMUNITY	Compliance to BS EN/EN55035, EAC TP TC 020,KC KN32,KN35(for LRS-350-12/24 only)							
OTHERS	MTBF	2099.9K hrs min. Telcordia SR-332 (Bellcore) ; 328.6Khrs min. MIL-HDBK-217F (25℃)							
	DIMENSION	215*115*30mm (L*W*H)							
	PACKING	0.76Kg; 15pcs/12.4Kg/0.78CUFT							

NOTE

1. All parameters NOT specially mentioned are measured at 230VAC input, rated load and 25℃ of ambient temperature.
2. Ripple & noise are measured at 20MHz of bandwidth by using a 12" twisted pair-wire terminated with a 0.1uf & 47uf parallel capacitor.
3. Tolerance : includes set up tolerance, line regulation and load regulation.
4. Line regulation is measured from low line to high line at rated load.
5. Load regulation is measured from 0% to 100% rated load.
6. Length of set up time is measured at cold first start. Turning ON/OFF the power supply very quickly may lead to increase of the set up time.
7. The 150% peak load capability is built in for up to 1 second for 12~48V.LRS-350 will enter hiccup mode if the peak load is delivered for over 1 second and will recover once it resumes to the rated current level(115VAC/230VAC).
8. The ambient temperature derating of 5℃/1000m is needed for operating altitude greater than 2000m(6500ft).
9. This power supply does not meet the harmonic current requirements outlined by BS EN/EN61000-3-2. Please do not use this power supply under the following conditions:
   a) the end-devices is used within the European Union, and
   b) the end-devices is connected to public mains supply with 220Vac or greater rated nominal voltage, and
   c) the power supply is:
      - installed in end-devices with average or continuous input power greater than 75W, or
      - belong to part of a lighting system

   Exception:
   Power supplies used within the following end-devices do not need to fulfill BS EN/EN61000-3-2
   a) professional equipment with a total rated input power greater than 1000W;
   b) symmetrically controlled heating elements with a rated power less than or equal to 200W

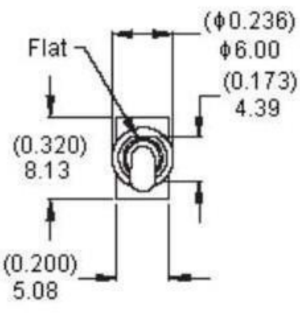
※ Product Liability Disclaimer : For detailed information, please refer to https://www.meanwell.com/serviceDisclaimer.aspx

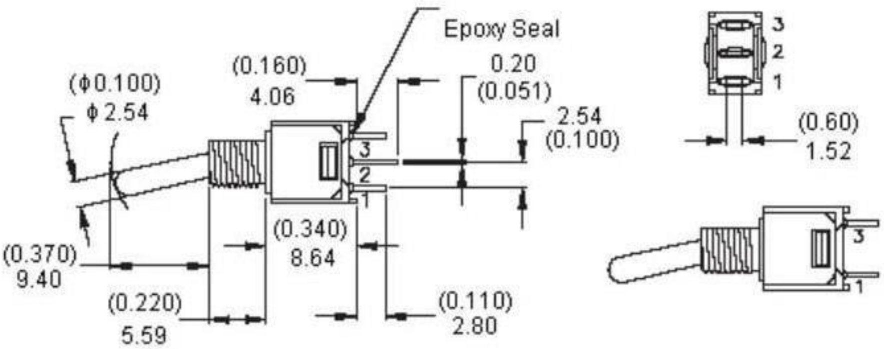
Specifications:

Contact Rating	: 0.4 volt-amps (VA) maximum at 20V maximum (AC or DC).
Mechanical Life	: 30,000 make-and-break cycles.
Contact Resistance	: 20mΩ maximum initial at 2 to 4V dc. 100mA for both silver and gold plated contacts.
Minimum Insulation Resistance	: 1,000MΩ.
Dielectric Strength	: 1,000VRMS at sea level.
Operating Temperature	: -30°C to 85°C.
Materials:	
Case and Bushing	: Diallyl phthalate (DAP).
Actuator	: Brass, chrome plated.
Bushing	: Brass, nickel plated.
Housing	: Stainless steel.
Switch Support	: Brass, tin plated.
Terminals/Contact	: Brass, with gold plated.

Pole Option

M2RE **SPDT**





Dimensions : Millimetres (Inches)

Appendix B: Program

```
// Pin Definitions
#define D_23_SDA 23
#define D_22_SCL 22
#define D_25_A28 25
#define D_26_A29 26
#define D_27_A27 27
#define TX_0 01
#define RX_0 03
#define D_21 21
#define D_19 19
#define D_18 18
#define D_05 05
#define TX_2 17
#define RX_2 16
#define D_04_A20 04
#define D_02_A22 02
#define D_15_A23 15
#define D_12_A25 12
#define D_13_A24 13
#define D_14_A26 14
#define V_P_A10 36
#define V_N_A13 39
#define D_32_A14 32
#define D_33_A15 33
#define D_34_A16 34
#define D_35_A17 35
```

```
// Blynk Configuration
#define BLYNK_TEMPLATE_ID "TMPL3Qoacc5-c"
#define BLYNK_TEMPLATE_NAME "iot based wireless vehicle charging station"
#define BLYNK_AUTH_TOKEN "oOMXRVMxN-dwV3ajowRUfkqk1hZtmGdo"
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

// Global Variables
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "BestProject";
char pass[] = "12345678";
int sense_2 = 15, Ir;
int sense_4 = 4, Ir2;

#include <LiquidCrystal.h>
LiquidCrystal lcd(D_05, D_18, D_19, D_21,  D_22_SCL,  D_23_SDA); // LCD Pin
Configuration

int p = 0;
int val;

#define PWM_12 12
#define PWM_13 13

int brightness = 0;    // PWM brightness
int fadeAmount = 10;    // PWM fade rate
int frequency = 10000;
```

```
bool charge_flag_1 = 0, charge_flag_2 = 0;

WidgetLED S_S1(V3); // Blynk LED Widget for Spot 1
WidgetLED S_S2(V4);  // Blynk LED Widget for Spot 2

// Blynk Callbacks for Button Widgets
BLYNK_WRITE(V1) {
  int v1 = param.asInt();
  if (v1 == 1) {
  charge_flag_1 = 1;
  } else {
    charge_flag_1 = 0;
  }
}

BLYNK_WRITE(V2) {
  int v2 = param.asInt();
  if (v2 == 1) {
  charge_flag_2 = 1;
  } else {
    charge_flag_2 = 0;
  }
}

void setup() {
  pinMode(PWM_12, OUTPUT);
  pinMode(PWM_13, OUTPUT);
  lcd.begin(16, 2); // Initialize LCD
```

```
  pinMode(sense_2, INPUT);
  pinMode(sense_4, INPUT);
  Blynk.begin(auth, ssid, pass);

  // Scrolling Animation on LCD during startup
  #define scrollength 40
  for (int i = scrollength; i > 15; i--) {
    lcd.clear();
    delay(70);
    lcd.setCursor(i, 1);   lcd.print("      wireless vehicle charging station");
    delay(50);
  }
}

void loop() {
  lcd.setCursor(0, 0);   lcd.print("Spot1      Spot2");

  // Check Spot 1
  if (digitalRead(sense_2) == LOW) {
    S_S1.on();
    if (charge_flag_2 == 1) {
      lcd.setCursor(0, 1); lcd.print("Charge");
      analogWrite(PWM_13, 110); // Control PWM for charging
    } else {
      lcd.setCursor(0, 1);  lcd.print(" OFF  ");
      analogWrite(PWM_13, 0);
    }
  } else {
```

```
    lcd.setCursor(0, 1);    lcd.print(" OFF ");
    analogWrite(PWM_13, 0);
    S_S1.off();
  }

  // Check Spot 2
  if (digitalRead(sense_4) == LOW) {
    S_S2.on();
    if (charge_flag_1 == 1 ) {
      lcd.setCursor(10, 1); lcd.print("Charge");
      analogWrite(PWM_12, 110); // Control PWM for charging
    } else {
      lcd.setCursor(10, 1);    lcd.print(" OFF  ");
      analogWrite(PWM_12, 0);
    }
  } else {
    lcd.setCursor(10, 1);
    lcd.print(" OFF  ");
    analogWrite(PWM_12, 0);
    S_S2.off();
  }
}
```

Appendix C: Bill of Materials (Component List & Costing)

Sr No.	Component Names	Price
1	Arduino Nano	1000
2	Winding Wire	500
3	Base Sheet	300
4	Resistor	100
5	Arduino USB cable	200
6	General Purpose PCB	50
8	Ribbon wire	60
10	Female header	16
11	Male header	16
12	Load Wire	150
13	Voltage regulator	150
14	Soldering Wire	20
15	White paper	50
16	Base sheet Stand	30
17	Pot	120
18	LCD 16x2	350
19	Heat Sink	100
20	Fitting Screws	10
21	Double side Tape	30
22	Capacitor	80
23	Diode	90
24	Super glue	10
25	Power Socket	120
26	MOSFET	250
27	Toy Car	550
28	Cardboard	150
	Total	**4382**

Appendix D: Research Publication (Publication/Patent/Copyright Proof)

IoT-Based Wireless EV Charging System for Electric Vehicle

Dr. Jyoti Kulkarni, Shruti Pingale, Yadnesh Kotkar, Atharva Kusurkar

Abstract - Electric cars (EVs) have been hailed for their social benefits by the auto industry, but wireless charging offers even more potential. An intelligent infrastructure is required for EV charging because traditional cable charging systems have problems with scalability, safety risks, and physical connection limits. A unique method of wireless EV charging uses the principles of inductive power transfer (IPT) to overcome these obstacles. The technology, which consists of three essential parts—the EV, charging station, and power supply unit—revolutionizes EV charging. The charging station's inbuilt power coils transmit a high-frequency AC signal that the power supply unit creates from grid-supplied AC electricity. Efficient power transfer to the EV is ensured by ground-based receiving coils, and smooth communication and control are made possible by IoT capabilities. To improve compatibility with EV systems, the power is converted to DC upon reception using a voltage regulator and rectifier. Real-time monitoring of energy use, battery health, and charging status is made possible by incorporated IoT technologies in the EV. By enabling intelligent charging patterns, load balancing, and demand response, this data maximizes energy efficiency and reduces grid stress. This wireless EV charging system combines IoT and IPT technologies to provide optimal efficiency, versatility, and user-friendliness. In addition to encouraging widespread EV use and reducing environmental effect, it signals a revolutionary move towards sustainable transportation infrastructure. As more people adopt greener energy options, wireless charging becomes apparent as a key component of the electric mobility revolution, with the potential to completely change the car industry going forward.

Keywords: Wireless Power Transmission, Inductive Power Transfer, IOT, EV.

I. INTRODUCTION

Transportation with automobiles has been around for a while. Internal combustion engines power these cars. As the number of cars rises, internal combustion engines (IC engines) contribute to environmental pollution and a decrease in the use of fossil fuels. Fuel efficiency and emissions are being reduced by new developments in the vehicle sector. Hybrid vehicles cut emissions while maintaining engine performance by combining internal combustion engines and electric motors. Clean, green energy that emits no emissions will be prioritized in the future. The development and production of electric vehicles have attracted a lot of industry attention. Batteries have three main drawbacks: they are expensive, have a short range, and require a long time to charge. Customers are constantly looking for ways to make travel more efficient. Consequently, all gas stations now have charging systems that are connected. The limitations of wired charging include things like socket locations, distance between charging stations, limited cable lengths, and the requirement to move the car in order to connect to the charger. Electric car wireless charging options can aid in resolving these problems. Systems may be installed anywhere, including residences, parking lots, and garages, and this enables flexible and hassle-free charging. Because they don't require wires or physical contact, Wireless Power Transfer (WPT) systems—especially those that use Wireless Inductive Power Transfer (IPT)—offer a number of benefits, including increased reliability, ease of use, safety, and lower maintenance costs.

These benefits make WPT systems appropriate for use in a variety of industries, including biomedical implants, textiles, space technology, mobile phones, and military applications. They are also appropriate for use in electric cars. It becomes vital in this situation to consider the idea of a wireless charger made especially for electric cars. In order to minimize stress on the electrical grid, this type of charger would use electromagnetic induction for connection and functioning. Nikola Tesla originally proposed inductive power transfer—which does not require a magnetic core—nearly a century ago with the intention of wirelessly transferring mains power across great distances. Ever since, medical equipment has found use for low-powered, closely connected wireless charging, and commercial goods that allow portable gadgets to be charged wirelessly using charging mats frequently available.

Systems for wireless inductive power transfer are generally divided into two groups according to their range: systems that are medium to long range and can be used in personal area networks, and systems that are short range and usually cover a distance of approximately 5 inches. The main area of interest for this research is intermediate wireless transfer capability. The focus of this study is on inductive coupling with matched resonance frequency, which highlights important aspects of effective wireless power transfer such as coil quality factor, resonance frequency alignment, link efficiency, and impedance matching. Non-radiative magnetic coupling is also investigated as a way to lower energy consumption and increase the suitability of WPT systems for medium-to long distance transmission.

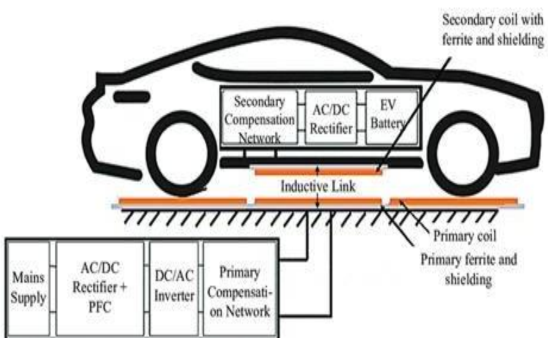


Fig 1. System prototype for wireless charging.

Table1: Methods of Wireless Power

Methods	Advantages	Negative elements
Coupling inductive	Easy, secure, and very effective transfer over short distances.	For short transmission distances, precise alignment is required.
Coupling of magnetic resonance	extended transmission range and radiation-free	adjusting the resonance frequency for various devices is difficult
Radiation from electromagnetic field	extremely high long-range transmission efficiency	extremely high long-range transmission efficiency.

II. METHODOLOGY

The technology of wireless charging is one that is growing quickly and has attracted a lot of attention lately. Monitoring the charging process to guarantee effective and secure charging is one of the difficulties with wireless charging. The ESP32 module is a well-liked option for tracking wireless charging stations due to its low power consumption and wireless capabilities. We go over some of the most current research on ESP32-based wireless charging station monitoring in this overview of the literature. Research indicates that using the ESP32 module as a foundation for monitoring wireless charging stations is dependable and effective. To guarantee effective and secure charging, The user can receive feedback, collect data, and monitor in real time with the ESP32 module. Further research is necessary in order to optimize the functionality and performance of ESP32-based wireless charging stations and explore the variety of potential applications for them.

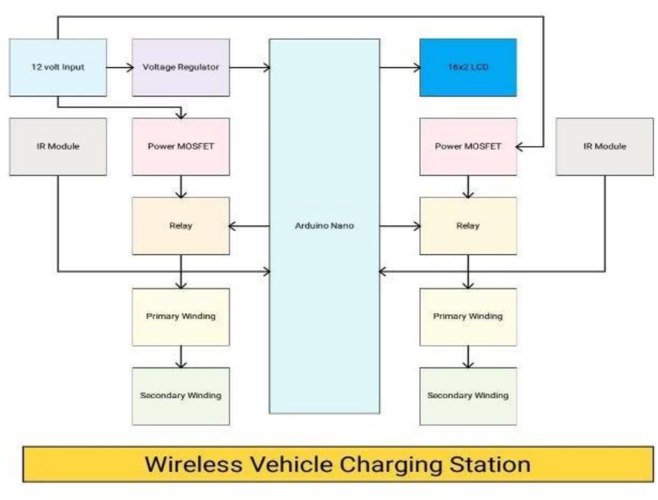


Fig 2. Proposed System's Block Diagram

Block diagram [2] an IoT-Based Wireless Vehicle Charging Station delineates the interconnected system components and their collaborative functioning. At the core of this setup lies the ESP32 Microcontroller, serving as the central control unit. This controller manages diverse operations such as communication with the app control interface, coordination of the charging process, interaction with various sensors and detectors, and implementation of power-saving measures. The charging system comprises Dual Spot Charging, facilitating the simultaneous wireless charging of two electric vehicles. This process is enabled through Inductive Power Coils, ensuring efficient energy transfer. The MOSFET (IRZ44N) regulates and controls the power flow, ensuring the safety and efficiency of the charging process. Interfacing with the app control interface, users can seamlessly manage and monitor the charging process via a mobile application. Commands initiated through the app interface are processed by the ESP32 controller, enabling actions like initiating or ceasing the charging process. Sensors and detectors integrated into the system include an IR Sensor responsible for vehicle detection and positioning, enabling automated charging when a vehicle is parked over the charging spot. The Auto Detection System identifies electric vehicles and triggers the initiation of the charging process automatically upon detection. Additionally, the system incorporates voltage regulation using a Voltage Regulator (7805) for stable voltage supply and energy-saving components to optimize power consumption. A Storage Battery (Lead Acid) acts as a backup power source, ensuring uninterrupted service in case of power failure or emergencies. Display functionalities are facilitated by a 16x2 LCD Display, providing real-time visual feedback on the charging status. Together, these components and their collaborative functioning, orchestrated by the ESP32 controller, create a robust and efficient wireless charging infrastructure for electric vehicles, focusing on user convenience, safety, and energy efficiency.

III. WIRELESS CHARGING SYSTEM ARCHITECTURE

Figure 3 illustrates the charging system, which includes many components. An alternating current (AC) supply is utilized to deliver high voltage.

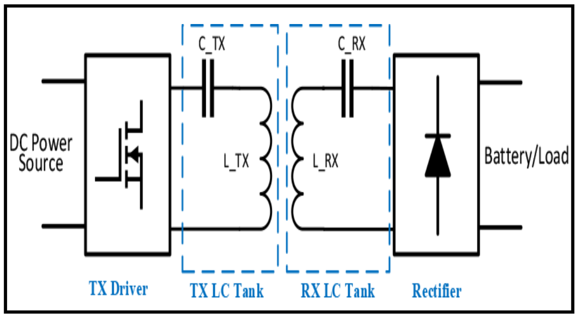


Figure 3: Circuit Model

Low frequencies are converted to high frequencies using a frequency converter (HF). The transmission coil (TX) is attached to this output. Resonant coupling is used to connect the receiving coil (RX). An AC-DC converter is used to convert the output to rectified DC, which is then utilized to charge the battery, which acts as the load. The coils used in the wireless power transmission project are called magnetic resonators. A fast-oscillating current is first fed to a coil at a specific resonance frequency using an HF converter. A reception coil should be tuned to the same resonant frequency as the source in order to produce a magnetic field surrounding a transmission coil. In doing so, the coupled magnetic response—an electrical current inside the receiving coil—will be coupled with the resonant magnetic field. A load can receive power in order to charge batteries. It is possible to divide this electricity across several loads.

The WPT system's basic circuit model, which is connected in a series-to-series topology, is shown in Figure 3. Considering the complexity of the system, evaluating the simplified equivalent network model is simple. L1 and L2, the circuit's primary and secondary windings, respectively. On the primary side, we have R1, C1, and on the secondary side, R2, C2.

The elements are passive and linear in character. The resonance of an RLC circuit is a feature. It is possible to adjust the LC values to get a resonant frequency between 10 and 30 kHz. The input voltage V1 and the total impedance of the secondary coil as seen by the primary determine the current flowing through the primary coil I1. The circuit's total impedance, or Ztotal, is determined by

$$Z\text{total}=R\text{equiv}+j(XL-XC) \qquad (1)$$

$$R\text{equiv}=R1+R2 \qquad (2)$$

$$XL=\omega 0(L1+L2) \qquad (3)$$

$$XC=\frac{1}{\omega 0}(C1+C2) \qquad (4)$$

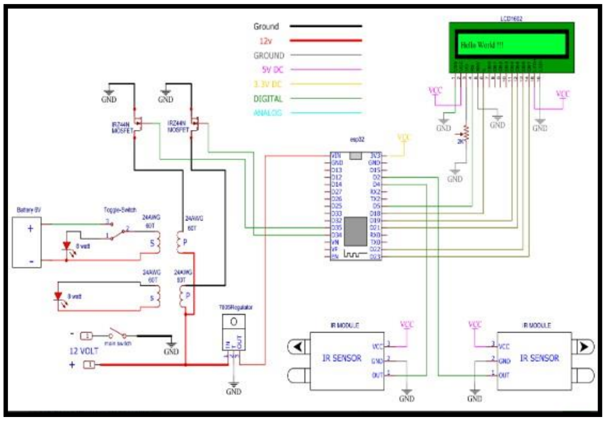


Figure 4: Schematic Diagram

An electric vehicle charging system's circuit diagram is displayed in Figure 3.2. The microcontroller, the central component of the system, regulates the operations of the linked devices in accordance with the specifications. Embedded C programming is used to create the suggested system using the Arduino Uno processor. The system's various sensors are depicted in the figure. A current sensor measures the current flowing through a wire and outputs a signal that is directly proportional to the current. An ammeter is used to display the measured current using the output signal, which can also be used for additional analysis. Another crucial sensor is the voltage sensor, which is primarily employed to translate observed voltage into a physically represented signal that is directly proportional to voltage. The measurement result is output by connection V, a physical signal port. Its unique feature is its ability to detect voltage levels without requiring metal-to-metal contact. Its components, which are embedded in a casted resin with a very low inductance, are resistive voltage dividers and integrated resistors. Together with the resin permittivity, which functions as a capacitance, the entire arrangement has a zigzag shape.

Node MCU, OLED, and Arduino Uno. The Microchip ATmega328P microcontroller, on which the Arduino Uno microcontroller board is based, includes analog and digital input/output pins that may be connected to a variety of expansion boards and circuits.

IV. SOFTWARE SPECIFICATIONS

Arduino IDE:

Specifications:

IDE for Legacy (1.8.X) - IDE for Arduino (1.8.19).

Blynk App:

Specifications:

Blynk IOT App- Version:2.27.34

Blynk is a versatile mobile application designed to simplify the process of creating IoT (Internet of Things) projects by enabling users to control and monitor connected devices remotely.

Fig 5: App Implementation Screenshots

V. SYSTEM FLOW

Step 1: Set Up Blynk Account and Project

Step 2: Install Blynk Library in Arduino IDE

Step 3: Hardware Connection:

Step 4: Write Arduino Sketch:

Step 5: Define Blynk Authentication Token:

Step 6: Set Up Virtual Pins:

Step 7: Write Code for Interfacing with Blynk App:

Step 8: Test Communication with Blynk App

Step 9: Debug and Refinement:

Step 10: Documentation and Deployment:

VI. CONCLUSION

In conclusion, wireless charging eliminates the need for bulky wires and plug points, making it a straightforward and cutting-edge way to charge electric cars (EVs). demonstrating the effectiveness and usefulness of this technology, when the EV is parked above the wireless charger, electricity is created in the coil located at the bottom of the vehicle by mutual induction. Additionally, the expansion of wireless charging to allow charging while driving signifies a substantial development in EV charging capabilities, offering users increased convenience and flexibility. With implications for the future of transportation infrastructure, this evolution highlights the ongoing innovation in the field of wireless power transfer.

This is the envisions future technologies like RFID tag payment and self-service entry and exit gates, highlighting the potential of wireless charging systems to change EV charging stations. The aforementioned enhancements are intended to optimize workflow, reduce traffic, and improve the overall user experience at charging stations. All things considered, the investigation of wireless charging technology in this work makes a significant addition to the area by providing insights into its effectiveness, use, and possible future advancements. As wireless charging develops further, it has the potential to completely disrupt not just the transportation sector but also a number of other industries, such as consumer electronics, healthcare, and industrial automation, thereby establishing itself as a game-change technological advancement.

VII. Future Work

Dynamic charging solutions that are high-performing, safe, and reasonably priced will be at the vanguard of the electric vehicle (EV) revolution, which has the potential to completely change road transportation in the future. Finding the best mix of capacitive and inductive. Wireless Power Transfer (WPT) technologies is essential to this evolution and offers huge research opportunities in near-field coupler design and high-frequency power electronics. Additional research should be done in a few crucial areas: The long-term health effects of being exposed to weak electric and magnetic fields produced by dynamic charging devices require more research in order to ensure the safety of both users and onlookers. To guarantee public safety and prevent mishaps, it is crucial to have strong systems for identifying live things and foreign items near WPT systems. To maximize the advantages of dynamic charging infrastructure, performance and cost-effectiveness must be optimized. This requires methods to identify the most efficient charger power levels and spacing. The development of methods for smoothly integrating WPT technology into traffic will be essential for its broad adoption and for making it possible for EVs to be conveniently charged while traveling.

References

[1] K.A. Kalwar, M. Aamir, S. Mekhilef "Inductively coupled power transfer (ICPT) for electric vehicle charging – a review",Renew. Sustain. Energy Rev., 47 (2015), pp. 462-475

[2] H. Barth, M. Jung, M. Braun, B. Schmülling, U. Reker"Concept Evaluation of an Inductive Charging System for Electric Vehicles",Presented at the 3rd European Conference SmartGrids and E-Mobility, Munchen, Germany (2011)

[3] M. SangCheol, K. Bong-Chul, C. Shin-Young, A. Chi-Hyung, M. Gun Woo"Analysis and design of a wireless power transfer system with an intermediate coil for high efficiency",Indust. Electr., IEEE Trans., 61 (2014), pp. 5861-5870.

[4]. J. Wu, B. Wang, W. S. Yerazunis & K. H. Teo (2013). Wireless power transfer with artificial magnetic conductors. in Proc. 2013 IEEE Wireless Power Transfer Conference, Perugia, Italy, 155-158, https://ieeexplore.ieee.org/abstract/document/6556906

5] Ronak Ramesh Sancheti, Chetan Shivaji Kurkute, Prasad Sanjay Karmalkar, Aryan Gupte, Dr. Preeti Patil,"Iot-Based Wireless EV Charging System For Electric Vehicle Using Inductive Power Coils." in IJCSPUB:Volume 13, Issue 2 May 2023 | ISSN: 2250-1770

6] P. Paul, P. Mohanty, S. S. Mahapatra, and D. K. Pradhan, "Design of Wireless Charging Station for Electric Vehicles using ESP32 with IoT-Based Monitoring System," in 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 57-62, doi: 10.1109/ICACCS52232.2021.9373304.

7] D. Mandal, S. Singh, S. Biswas, S. Roy, S. S. Saha, and S. K. Ray, "Design and Implementation of a Multi-Device Wireless Charging Station Using ESP32," in 2021 6th International Conference on Control, Automation and Robotics (ICCAR), Nagoya, Japan, 2021, pp. 385-390, doi: 10.1109/ICCAR50762.2021.9428705

8] S. Obayashi, Y. Kanekiyo and T. Shijo, "UAV/Drone Fast Wireless Charging FRP Frustum Port for 85-kHz 50-V 10-A Inductive Power Transfer," 2020 IEEE Wireless Power Transfer Conference (WPTC), 2020, pp. 219-222, doi: 10.1109/WPTC48563.2020.9295562